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Physics Abstracts

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PHYSICS ABSTRACTS

Volume 60 OCTOBER 1957 Number 718

MATHEMATICS 51

512.9

8348. ALGEBRAIC TABLE OF VECTOR-ADDITION COEFFICIENTS FOR $j_2 = 5/2$. M.A.Melvin and N.V.V.J.Swamy.
Phys. Rev., Vol. 107, No. 1, 186-9 (July 1, 1957).

Vector-addition coefficients are given by a terminating hypergeometric sum of the ${}_3F_2$ type, which is easily converted to a simplified form. This form is equivalent to those found independently by Gaunt, van der Waerden, and Racah. It is used to fill the gap for $j_2 = \frac{5}{2}$ in the literature of published algebraic tables. A.

517.43 : 530.145

8349. A NOTE ON A PROOF BY DYSON. R.O.A.Robinson.
Canad. J. Phys., Vol. 35, No. 1, 122-4 (Jan., 1957).

The object of this note is to bring out explicitly a point in Dyson's simplified proof of the theorem (1952) regarding the expansion in normal form of any simple product of electron—positron and electromagnetic field operators, viz., that expansions in accordance with the theorem are additive. W.A.Hepner

517.544.2

8350. SOME RELATIONS AMONG GREEN'S FUNCTIONS. K.Hiida and M.Sawamura.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 896-906 (April, 1957).

Starting from several physically reasonable assumptions taken by Källén and Lehmann, various Green's functions are transformed into the parametrical integral form with spectral functions. Then a method is presented to convert the equations connecting various Green's functions into those among the corresponding spectral functions alone. A.

517.6

8351. TABLE OF TWO-CENTRE INTEGRALS. J.Tillieu, J.Baudet and J.Guy.
J. Phys. Radium, Vol. 18, No. 7, 455-8 (July, 1957). In French.

Some two centres integrals, occurring in the study of molecular properties (especially for magnetic susceptibilities), are tabulated in a condensed form, allowing fast numerical computations. Integrals of the form

$$D_n(b) = \int_{-1}^{+1} \mu^n (1 - \mu^2)^{1/2} e^{-b\mu} \, d\mu \quad \text{(n positive integer)}$$

are also evaluated. A.

518.5

8352. THE OPTIMUM DESIGN OF QUARTER-SQUARES MULTIPLIERS WITH SEGMENTED CHARACTERISTICS. M.E.Fisher.
J. sci. Instrum., Vol. 34, No. 8, 312-16 (Aug., 1957).

A general discussion of quarter-squares multiplication shows that there are no serious disadvantages in the use of non-linear units with monotonic characteristics. The total truncation error, due to the approximation of the ideal non-linear characteristics by a finite number of equal linear segments, is evaluated. Formulae are deduced for optimizing a multiplier's performance in specified applications by using segments of unequal lengths. In typical cases savings of between 5 and 20% in the number of segments needed for a given accuracy can be achieved: the optimum distributions of segment lengths differ only slightly from the uniform distribution with equal segments. A.

518.5 : 539.172.4 : 681.142 : 621.317.79

8353. AN ANALOGUE COMPUTER FOR NUCLEAR POWER STUDIES. G.J.R.MacLusky.
Proc. Instn Elect. Engrs, Paper 2337M, publ. March, 1957 (Vol. 104B, 433-42, 447-51).

Republication, with discussion, of the paper abstracted in Abstr. 2911 (1957).

ASTRONOMY . ASTROPHYSICS . GEODESY 52

523.11 : 539.16.08

8354. A LOWER LIMIT FOR THE AGE OF THE UNIVERSE. E.Schumacher.
Experientia, Vol. 13, No. 3, 104-5 (March 15, 1957). In German.

Measurements of the Sr^{86}/Rb^{87} ratio for a meteorite give its age as $(4.5 \pm 0.4) \times 10^9$ years. A.O.Stanesby

523.112 : 530.12

8355. ON MACH'S PRINCIPLE AND SOME RELATED QUESTIONS. O.Costa de Beauregard.
J. Phys. Radium, Vol. 18, No. 3, 204 (March, 1957). In French.

See Abstr. 5797 (1957). The quantity $(\gamma_2 g^{\lambda\mu} - R^{\lambda\mu})/\kappa$ is interpreted as gravitational energy-momentum density, and the contracted field equation $-R = \kappa T$ is related to Park's formulation of Mach's principle. R.A.Newing

523.162

8356. BAND-WIDTH EFFECTS IN PHOTOELECTRIC PHOTOMETRY. V.M.Blanco.
Astrophys. J., Vol. 125, No. 1, 209-12 (Jan., 1957).

The effects of the extended bandwidths of the filters used in observations of the interstellar absorption law are studied, and a monochromatic law of interstellar absorption is derived. Similar effects in the determination of atmospheric extinctions in the (U,B,V) system are studied. The observed U magnitudes and U—B colours for no atmosphere are found to be systematically too large by 0.04 mag. A.

523.164 : 551.510.535

RADIO STAR SCINTILLATIONS CAUSED BY INTERSTELLAR PARTICLES ENTERING THE IONOSPHERE. See Abstr. 8317-19

523.35 : 523.164

8357. RADIO OBSERVATIONS OF THE LUNAR ATMOSPHERE. B.Elsmore.
Phil. Mag. (Eighth Ser.), Vol. 2, 1040-6 (Aug., 1957).

On January 24, 1956 observations were made at a wavelength of 3.7 metres, of the lunar occultation of the Crab Nebula. A comparison of the time of obscuration of the nebula with the computed value enabled the refraction occurring in the lunar atmosphere to be estimated. An electron density at the moon's surface of about 10^3 cm^{-3} was derived for cases of both an atmosphere in hydrostatic equilibrium and for an atmosphere which is continuously escaping; a figure which corresponds to a surface density of the lunar atmosphere about 2×10^{-13} of that of the earth's atmosphere at normal temperature and pressure. A.

523.4

8358. FLUORESCENCE IN PLANETARY ATMOSPHERES. H.C.Urey and A.W.Brewer.
Proc. Roy. Soc. A, Vol. 241, 37-43 (July 23, 1957).

It is pointed out that ions and free radicals will exist in the high atmospheres of the planets and that these ions will absorb and fluoresce in the visible and near ultraviolet radiations. Applications

of this effect to the problem of the colour of Venus, the blue haze of Mars, the variation of brightness of Jupiter and the haze of Mercury are discussed. The presence of a tenuous atmosphere on Mercury is justified by its equilibrium with the local interplanetary gas. A.

523.6

8359. THE SUNWARD TAIL OF COMET AREND-ROLAND. F.L.Whipple.
Nature (London), Vol. 179, 1240 (June 15, 1957).

Measurements of photographs of the comet show that the sunward "spike" was most prominent as the earth passed through the plane of the comet's orbit. It is suggested that the phenomenon was due to scattering by a concentration of cometary debris over an area of the orbital plane. The formation of such a distribution of debris finds a ready explanation on the "ice" model of a comet, the sunward sublimation of an icy fragment effectively diminishing the solar attraction for short periods. M.W.Ovenden

523.852.22

8360. MAGNETIC FIELDS IN PLANETARY NEBULAE. G.A.Gurzadyan.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 6, 1231-4 (1957). In Russian.

Three hypotheses are discussed for the formation of bipolar planetary nebulae (i.e. having "caps" or maxima of brightness at the ends of the minor axis): (1) They are due to the general magnetic field of the Galaxy. Lack of correlation between the direction of the field and an axis of the nebula leads to the rejection of this hypothesis. (2) The central nucleus star has a dipole magnetic field. This is satisfactory only when the magnetic axis and the axis of the star's rotation approximately coincide — otherwise the nebula should be homogeneous. (3) A magnetic field is frozen into the matter ejected from the nucleus during the formation of the planetary nebula. This can account for both bipolar and annular types and explains their elongated forms. G.A.Chisnall

523.877

8361. INHOMOGENEOUS STELLAR MODELS. V. A SOLAR MODEL WITH CONVECTIVE ENVELOPE AND INHOMOGENEOUS INTERIOR. M.Schwarzschild, R.Howard and R.Härm.
Astrophys. J., Vol. 125, No. 1, 233-41 (Jan., 1957).

For Pt IV see Abstr. 4323 (1955). A model for the sun has been computed in which account has been taken both of the deep hydrogen convection zone and of the internal inhomogeneity in composition caused by the transmutation of hydrogen during the last five billion years. The model is found to permit good agreement with the analysis of the solar photosphere as regards chemical composition and as regards the depth of the hydrogen convection zone. Furthermore, the model indicates that the sun must have become brighter by nearly $\frac{1}{2}$ mag. during the five billion years. A.

523.877

8362. INHOMOGENEOUS STELLAR MODELS. VI. AN IMPROVED SOLAR MODEL WITH THE CARBON CYCLE INCLUDED. R.Weymann.
Astrophys. J., Vol. 126, No. 1, 208-12 (July, 1957).

An improved solar model is computed in which the effect of the carbon cycle is taken into account and an improved run of chemical inhomogeneity used. The results differ only slightly from those obtained previously. The core of the sun is found not to be convective. A.

529.786

8363. ACCELERATING SPHERICAL LIGHT WAVE CLOCKS IN CHRONOGEOMETRY. A.D.Fokker.
Physica, Vol. 22, No. 12, 1279-82 (Dec., 1956).

The empirical result of Michelson and Morley is symbolized in the behaviour of a spherical light wave inside a rigid spherical mirror. This affords the model of an idealized instrument which is clock and yard-stick both in one. It is shown that the focusing of the spherical light wave is not disturbed by accelerating the rigid mirror. A.

529.786 : 535.343

FREQUENCY SHIFT IN AMMONIA ABSORPTION. See Abstr. 7759-60

PHYSICS 53

FUNDAMENTALS 530.1

530.12

8364. PHENOMENOLOGICAL LINEAR THEORY OF GRAVITATION. I. CLASSICAL MECHANICS. F.J.Belinfante and J.C.Swihart.
Ann. Phys. (New York), Vol. 1, No. 2, 168-95 (May, 1957).

Reasons are given why a linear theory of gravitation, if not the final word on gravity, yet is of considerable interest. Starting from a theory of considerable generality, this generality is narrowed down by choosing the various constants in the theory on considerations of convenience as well as adjustment to experimental data; two of the constants are made zero. The number of facts predicted by the theory exceeds the number of adjustable constants appearing in it. This theory differs from both Birkhoff's or Moshinsky's theory and from the linearization of Einstein's theory. The authors explain the choice of the gravitational Lagrangian and discuss the choice of interaction of gravity with particles and other fields. The static gravitational field around the sun assumed to be at rest is calculated. Gravitational effects due to stresses inside the sun are taken into account as they are of slightly larger magnitude than the relativistic effects leading to the advance of the perihelion. The equations of motion of a point mass in this gravitational field are discussed and both slow particles (e.g. Kepler orbits of planets) and fast particles (e.g. photons passing the sun) are considered. When the slow-particle case is expanded to second-order terms in v^2/c^2, the advance of the perihelion is found. The results are compared with available experimental evidence, and the choice of the constants of the theory is given as a function of the more accurate results which future experiments may procure. Some possible choices of the constants are indicated. A.

530.12

8365. PHENOMENOLOGICAL LINEAR THEORY OF GRAVITATION. II. INTERACTION WITH THE MAXWELL FIELD. F.J.Belinfante and J.C.Swihart.
Ann. Phys. (New York), Vol. 1, No. 2, 196-212 (May, 1957).

The theory of Pt I is applied to the interaction of gravity, matter and electromagnetism. Maxwell's equations are valid with an apparent electric and magnetic susceptibility of space due to the gravitational field. One effect of this susceptibility is a refraction of light rays by a gravitational field, from which the bending of light rays passing the sun can be derived. The result is the same as found in Pt I for the deviation of particles travelling at the speed of light. The equivalence principle is shown to be valid in the linear theory as in Einstein's theory, notwithstanding the velocity dependence of the gravitational acceleration of free particles. For bound particles the dependence of the gravitational forces on the relative velocities of parts of a system with respect to the system's centre of gravity is neutralized by gravitational effects on the binding forces. This is shown only for a special case, and the calculation is performed only in electrostatic approximation. As the errors thus introduced cancel in Einstein's theory, it is assumed that they cancel also here. The parallelism with the corresponding derivations in Einstein's theory are apparent at each step of the calculation, and remains, with altered numerical coefficients in the formulae, for any values assigned to the constants of the linear theory of gravitation. It is, however, possible that in higher approximations this linear theory would violate the equivalence principle. This question is worth further theoretical investigation, and, if such effects theoretically would follow from the theory, Eötvös's experiments on the equivalence principle should be pushed from 10^{-8} to 10^{-11} in order to discover such effects and to make an experimental decision between the linear and the general-relativistic theories of gravitation. A.

530.12

8366. INFLUENCE OF STRONG GRAVITATIONAL FIELD ON PROPAGATION OF LIGHT. G.V.Skrotskii.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 1, 73-6 (1957). In Russian.

The lowest-order coupling terms between a Maxwell and gravitational field are evaluated for the case where the metric tensor includes an angular momentum term as well as the "gravitational fine-structure constant". J.W.Gardner

530.12 : 530.145

8367. MODEL OF AN INFINITE PARTICLE. M.Hessaby.
J. Phys. Radium, Vol. 18, No. 5, 323-6 (May, 1957). In French.

Considering the gravitational field as a limiting case of the electromagnetic field in general relativity, in which the charge density vanishes at every point in space, the author deduces a metric tensor for the field of an uncharged particle giving a mass density which is finite at all points in space and tends to zero at infinity, the integral of the mass density taken over all space being equal to the mass of the particle, the greatest part of the mass being concentrated in the neighbourhood of the centre of symmetry of the particle. The form of the electrostatic field of a charged particle which is obtained leads similarly to a distribution of charge density and energy density through all space. The electromagnetic wave equation is interpreted so as to explain a directing action of the wave obtained in wave mechanics on the moving particle. It is remarked that in the force tensor in the static case, a torsional term appears, which may be analogous to the spin. A.

530.12

8368. PLANE GRAVITATIONAL WAVES IN GENERAL RELATIVITY. H.Bondi.
Nature (London), Vol. 179, 1072-3 (May 25, 1957).

A singularity-free metric is reported corresponding to a plane-wave zone of finite extent. It is claimed that the waves defined could carry energy since they can impart motion to a system of test particles. R.A.Newing

530.12 : 530.145

8369. GRAVITATIONAL FORCES AND QUANTUM THEORY. P.Bocchieri and P.Gulmanelli.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 1016-17 (April, 1957).

The possibility of gravitational forces arising from double neutrino exchange is discussed and a convergent β-decay model is set up for this process. G.Stephenson

530.12 : 537.122

8370. REVIEW OF THE EXPERIMENTAL EVIDENCE FOR THE LAW OF VARIATION OF THE ELECTRON MASS WITH VELOCITY. P.S.Faragó and L.Jánossy.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1411-36 (June, 1957).

Reviews the actual experiments in which the dependence of electron mass on velocity is investigated. It is found that the most precise verification of the relativistic formula follows from the fine structure doublet separation of hydrogen-like spectra. Regarding the direct experiments on the behaviour of free electrons, the results do not contradict the relativistic formula, although the experimental error of the available measurements is rather high; i.e. it is in most cases comparable with the difference between theoretical formulae derived from different assumptions. Recent measurements on the velocity dependence of the mass of protons are also reviewed. A.

530.12

8371. A GENERALIZATION OF REISSNER–NORDSTRÖM SOLUTION. II. R.L.Brahmachary.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1520-3 (June, 1957).

For Pt I, see Abstr. 5028 (1957). Following Tolman, two special solutions of the field equations are easily obtained, when the energy tensor consists of two parts, namely the electromagnetic and the material parts. The second solution, obtained by assuming $e^{\nu}(\nu'/2r)$ = constant is discussed. Another solution based on the very restrictive assumption $\rho = -p$ is also obtained and the validity of Birkhoff's theorem for the case of a charged sphere is shown. A.

530.145

8372. SOME COMMENTS ON THE QUESTION OF THE HIDDEN PARAMETER. P.Bocchieri and A.Loinger.
Z. Phys., Vol. 148, No. 3, 308-13 (1957). In German.

The question of the existence of hidden parameters in quantum theory is re-examined, and recent criticisms against the legitimacy of von Neumann's conclusion are discussed. It is in particular emphasized that not only the quantum theory, but also any probabilistic theory which admits only one-variable distribution functions cannot be supplemented with hidden parameters to give a deterministic theory. A.

530.145

8373. ON THE DOUBLE COVARIANCE CONCEPT (QUANTUM AND RELATIVISTIC) IN SECOND QUANTIZATION THEORY. R.Potier.
J. Phys. Radium, Vol. 18, No. 7, 422-33 (July, 1957). In French.

The aim of this paper is to set up as rigorously as possible a mathematical basis for the theory of quantized fields. A generalization of relativity principle enables one to give the state vector of a particle system a sound definition, to build unambiguously the second quantization operators and to form the well known spin-statistics correspondence. Thanks to Costa de Beauregard's invariant scalar product concept, the whole theory can be expressed in an obviously covariant form. Including automatically indefinite metrics and revealing the true mathematical nature of questions the quantum theory of fields asks, the attempt, which does not assume the existence of a Lagrangian function, appears as being both a simple and general approach to the problem. A.

530.145

8374. DERIVATION OF THE FUNCTIONAL INTEGRAL FORMALISM FOR FERMI SYSTEMS FROM THE CANONICAL FORMALISM. W.K.Burton and A.H.de Borde.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1510-19 (June, 1957).

Using the canonical formulation of the quantum theory of fields, the functional integral formalism is derived for systems obeying anticommutation rules. A prescription for the evaluations of the appropriate functional integrals, using normal techniques is thereby obtained. A.

530.145

8375. GRAVITATIONAL FORCES AND QUANTUM FIELD THEORY. P.Gulmanelli and E.Montaldi.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1716-21 (June, 1957).

The Gamow–Teller hypothesis, according to which an exchange of neutrino pairs could give rise to a gravitational type potential between nucleons, is re-examined. By introducing a new boson field it is shown that this guess cannot be valid at least in the frame of the usual linear field theories. A.

530.145

8376. ON THE FORMULATION OF QUANTIZED FIELD THEORIES. II. H.Lehmann, K.Symanzik and W.Zimmermann.
Nuovo Cimento, Vol. 6, No. 2, 319-33 (Aug., 1957).

For previous work, see Abstr. 1510, 9411 (1955). The concept of causal scattering matrices is discussed using retarded multiple commutators of field operators. A.

530.145

8377. EXACTLY RENORMALIZABLE MODEL IN THE QUANTUM THEORY OF FIELDS. T.W.Ruijgrok and L.van Hove.
Physica, Vol. 22, No. 10, 880-6 (Oct., 1956).

A simple model is considered for the interaction of a boson field with infinitely heavy nucleons, susceptible of an exact determination of the physical nucleon states and of the renormalization constants. It incorporates as special cases the Lee model and the neutral scalar field in scalar interaction with heavy nucleons. The renormalized coupling constants remain different from zero for infinite cut-off although part of the physical effects of the coupling vanish in this limit. The system becomes then essentially equivalent to the neutral scalar field in scalar interaction with heavy nucleons, which gives vanishing boson–nucleon scattering but non-vanishing nucleon–nucleon interaction. A.

530.145

8378. APPLICATION OF THE RENORMALIZATION GROUP TO VARIOUS SCATTERING PROBLEMS IN QUANTUM ELECTRODYNAMICS. V.Z.Blank.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 932-3 (1957). In Russian.

Using the technique of generalized Feynman diagrams given by Abrikosov (Abstr. 4811/1956) one can write down the transition matrix element M. In cases of interest, $M = M_0$, where M_0 is the matrix element in lowest order perturbation theory and $\mathcal{M}$ contains all radiative corrections. Using the renormalization group technique, an integral equation can be found for $\mathcal{M}$. G.E.Brown

530.145

8379. "DYNAMICAL" LAGRANGIAN FOR THE MANY BODY PROBLEM. J.K.Percus and G.J.Yevick.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 65-82 (Jan., 1957).

A "dynamical" Lagrangian approach to the many body problem in the collective coordinate formulation is made possible with the aid of the two-body correlation function. As a consequence, the values of the fictitious masses and frequencies for the collective coordinate harmonic oscillators, which represent the physical problem, are

dependent on the average motion of the system. Moreover, the introduction of the centre of mass and relative coordinates for the q_k occasions no difficulty in the present approach. Preliminary considerations are presented on the physical extent of the domain of action of q-space; various techniques are utilized to probe its structure. It is found in this way that the "diameter" of q-space is of the order of $N^{1/2}$. Application is made to the speed of sound in a fluid. A.

530.145

8380. ELECTROMAGNETIC PROPERTIES OF THE PROTON AND RENORMALIZATION OF THE COUPLING CONSTANT. L.Tenaglia.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 220-8 (Jan., 1957). In Italian.

Reports calculations on the interaction between proton, pseudoscalar mesonic field and static sources of the electric and magnetic field, following the relativistic perturbation theory for weak coupling. It is shown that a renormalization method which eliminates only the divergent terms of the matrix elements (of 1st and 2nd order) is not sufficient to obtain physically consistent results. A.

530.145

8381. RENORMALIZATION IN NON-RELATIVISTIC FIELD THEORIES. (REMARKS ABOUT THE PAPER BY ENZ). W.Heitler.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 302-5 (Jan., 1957).

Examines to what extent Enz's formulae (Abstr. 1053/1957). remain valid when calculated as a limiting case of the relativistic theory. P.M.Davidson

530.145

8382. ON LEHMANN'S METHOD OF RENORMALIZATION. N.Nakanishi.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 520-2 (Feb., 1957).

Considering a scalar one-body propagator it is shown that Dyson's renormalization prescription can be obtained by Lehmann's method (Abstr. 5288/1954). The case of an unstable particle is included. W.A.Hepner

530.145

8383. ON THE IMPOSSIBILITY OF THE HAMILTONIAN FORMULATION OF THEORY WITH THE FORM-FACTOR. V.S.Barašenkov.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1469-79 (June, 1957).

It is shown that the Hamiltonian structure is not proper to the theory with non-local interaction; the latter may be formulated, however, both in Lagrangian x_k; $\dot{x}_k$; A_μ; $\dot{A}_\mu$ and Hamiltonian variables x_k; p_k; A_μ; π_μ. With the help of an example of a one-dimensional oscillator Pauli's method is considered. The initial integro-differential equation of motion and the canonical system of equations of motion obtained by the Pauli method are not equivalent. The many-time equations of motion obtained by Hayashi's method turn out to be incompatible in any K-approximation of the perturbation theory. A.

530.145

8384. A MODEL FOR THE WEAK INTERACTIONS. S.Goto.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1573-88 (June, 1957).

By assigning iso-spin to be zero and strangeness u to be 2, –2 and 0 for the leptons μ^+, e^- and ν respectively, the universality of the weak interactions including the lepton processes is shown to be consistently derived if the strong primary interactions are assumed to be of the Yukawa type and the weak primary interactions of the Fermi one. A.

530.145

8385. INDIVIDUAL MASS REVERSAL AND PARITY NON-CONSERVATION. S.Hori and A.Wakasa.
Nuovo Cimento, Vol. 6, No. 2, 304-10 (Aug., 1957).

Some consequences of the assumption that every interaction which exists in Nature never allows us to determine the signs of masses of all elementary particles, are discussed. The assumption entails the postulate of invariance of all interactions under a set of transformations which are called Individual Mass Reversal. The electromagnetic interaction and the $\pi-N$ interaction, being parity-conserving, are compatible with the postulate, provided that the latter is a PS(PV) coupling. Most of Fermi interactions and interactions such as $\Lambda N\pi$ and ΛNK are not allowed, unless they do not conserve parity. Although some strong interactions are parity-non-conserving in this theory, no serious difficulty does arise if a charge conjugate state is redefined as was suggested by L.Landau, since the theory is proved to be invariant under the product of charge conjugation and space inversion. The theory is equivalent to the two component neutrino theory of T.D.Lee and C.N.Yang for neutrino processes, except the μ--e decay. A.

530.145

8386. ON THE QUESTION OF NON-CONSERVATION OF PARITY IN WEAK INTERACTIONS. B.L.Ioffe, L.B.Okun' and A.P.Rudik.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 396-7 (1957). In Russian.

Parity conservation is not an ineluctable concomitant of weak interactions; indeed some decay schemes for strange particles require its violation. The question of charge conservation in weak interactions is not resolved. J.W.Gardner

530.145

8387. THE MASS OF THE NEUTRINO AND THE NON-CONSERVATION OF PARITY. B.F.Touschek.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1281-91 (May, 1957).

A special form of the theory of Lee and Yang (Abstr. 5596/1957) is obtained by imposing an invariance principle, which insures that the mass as well as the magnetic moment of the neutrino is identically zero. This invariance property leads to the conservation of a quantum number n. The non-conservation of parity is discussed for the chain of decays $\pi \to \mu + \nu$, $\mu \to e + \bar{\nu} + \nu$. It is shown that the present theory contains as a special case the "screwon" theory recently proposed by Lee and Yang and a similar theory proposed by Salam. A.

530.145

8388. ON THE GAUGE INVARIANCE OF NEUTRINO FIELDS. Tzou Kuo-Hsien.
C.R. Acad. Sci. (Paris), Vol. 245, No. 5, 502-5 (July 29, 1957). In French.

530.145

8389. ON THE PROBLEM OF A FUNDAMENTAL RELATIVISTICALLY INVARIANT EQUATION FOR SPIN ½ PARTICLES. G.A.Zaĭtsev.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 6, 1248-50 (1957). In Russian.

An operational procedure which preserves Lorentz invariance is used to formulate the "anomalous" magnetic moment terms in the eigenfunctions of certain fermions, which are then substituted back in the fundamental equation of motion. J.W.Gardner

530.145

8390. DISPLACEMENT OF ENERGY LEVELS OF SPIN ½ PARTICLE IN A COULOMB FIELD. G.A.Zaĭtsev.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 1, 61-3 (1957). In Russian.

The Hamiltonian for a general fermion in a Coulomb potential is expanded in spherical polar coordinates using a straightforward extension of Pauli spin matrices. The interaction displacement energy is related to the anomalous magnetic moment. J.W.Gardner

530.145

8391. "HANDED" PARTICLE OF SPIN ½ WITH FINITE MASS. S.Watanabe.
Nuovo Cimento, Vol. 6, No. 1, 187-96 (July, 1957).

It is possible to formulate a four-component spinor theory for a particle of spin ½ with a definite chirality (handed-ness), which has a finite mass. Interaction between an achiral (nonhanded) spinor and a chiral spinor requires an eight-component framework. Such an interaction manifests a parity-violating property. Two formulations are possible: (1) The theory can be made invariant separately for time-reversal and for the combination of space-inversion and charge-conjugation, or (2) it can be made invariant for space-and-time-inversion and for charge-conjugation. The present theory may have applications for hyperons. The Salam–Lee–Yang–Landau type of neutrino theory can be derived from the present formalism for the case m = 0. A.

530.145

8392. SECOND RANK SPINORS WITH INVARIANT COMPONENTS AND SPINOR FORMALISM INCLUDING PARITY. J.Winogradzky.
J. Phys. Radium, Vol. 18, No. 6, 387-94 (June, 1957). In French.

Determination of all the second rank Dirac spinors whose components are invariant under the following groups: group of the inversions $x^k = \pm x'^k$, orthochronous proper Lorentz group, general Lorentz group. It is shown that the knowledge of these spinors leads to a more satisfactory formalism than the usual one. A.

530.145

8393. RELATIVISTIC KINEMATICS OF A CLASSICAL POINT PARTICLE IN SPINOR FORM. F.Gürsey.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 784-809 (April, 1957).

A proper Frenet tetrad is associated with each point of the world-line of a classical point particle. It is shown that this is equivalent to the introduction of a unimodular 2 x 2 matrix (or, correspondingly, a suitably normed 4-spinor) as a function of the proper time, this "proper 4-spinor" being determined by the Lorent

transformation which transforms a fixed set of Cartesian axes into the proper tetrad at the point considered. The rate of change of the proper 4-spinor as the particle moves along the world-line is given by a spinor equation which involves the three curvatures and is entirely equivalent to the Frenet formulae. The proper 4-spinor is determined for simple types of world-lines. In particular, it is shown that in the case of 4-dimensional helices for which the third curvature vanishes and the other two curvatures remain constant, one obtains the world-line of a free spinning particle as described by Weyssenhoff while the proper 4-spinor attached to such a particle satisfies the classical analogue of Dirac's equation recently postulated by Proca. A.

530.145

8394. BILOCAL FIELD THEORIES AND THEIR EXPERIMENTAL TESTS. II. J.Rayski.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 872-85 (April, 1957).

For Pt I see Abstr. 2981 (1957). A theory of heavy particles accounting for the existence and characteristic properties of hyperons and heavy mesons is presented. It offers a qualitative and quantitative explanation of the mass spectra. A physical interpretation of mass, charge, isotopic spin, attribute, and of Gell-Mann's selection rules is proposed. A.

530.145

8395. A REPLY TO A CRITICISM BY MR.A.GAMBA. K.M.Case, C.N.Yang and R.Karplus.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 1004 (April, 1957).

See Abstr. 7130 (1956).

530.145

8396. ELECTROMAGNETIC PROPERTIES OF PARTICLES WITH SPIN. V.Glaser and B.Jakšić.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1197-202 (May, 1957).

The scattering of a relativistic electron on particles with some electromagnetic structure and spin up to $s = \frac{3}{2}$ is investigated, and the cross-sections, in the first Born approximation for the electromagnetic field, are calculated. A possible estimation of the proton radius is given on the basis of quite general arguments. A.

530.145

8397. ON THE CONSERVATION OF THE LEPTON CHARGE. W.Pauli.
Nuovo Cimento, Vol. 6, No. 1, 204-15 (July, 1957).

The independence of the conservation law for light particles ("lepton charge") on other invariance properties of the theory of weak interactions, including the two component theory of the neutrino, is shown. Using invariance properties of S-matrix elements with respect to canonical transformations which leave initial and final state unchanged, those expressions of the second degree in the coupling constants are found which in the matrix elements for double-processes of negaton emission would violate the conservation law, which can alone occur. The two component neutrino theory is hereby a special case. A.

530.145

8398. HIGH-ENERGY, SEMICLASSICAL SCATTERING PROCESSES. B.A.Lippmann.
Ann.Phys. (New York), Vol. 1, No. 2, 113-19 (May, 1957).

The formal theory of scattering by two potentials, V_1 and V_2, where the scattering by V_1 alone is known exactly, can be put in the form of an integral equation, the inhomogeneous term of which gives the amplitude for scattering by V_1 alone, while each iteration contributes an additional scattering by V_2. This integral equation is derived here and is applied to the case where both V_1 and V_2 correspond to scattering in the high-energy, semiclassical domain. V_1 is taken as that part of the potential that results in zero-angle scattering, while V_2, the remainder, produces scattering through finite angles. With this identification, the inhomogeneous term of the integral equation corresponds to the W.K.B. approximation in the high-energy domain and also agrees with the wave-function of Gol'dman and Migdal; the first iteration yields the wave-function recently proposed by Schiff, while the infinitely iterated series gives the exact wave-function in terms of straight-line W.K.B. paths combined with finite-angle scatterings. In the initial discussion, an operation, λ-conjugation, is introduced which appears to be useful in the formalism of scattering theory. A.

530.145

8399. ON THE SOLUTION OF THE TRANSPORT EQUATION FOR STRONGLY ANISOTROPIC SCATTERING. T.A.Germogenova.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 2, 297-300 (1957). In Russian.

An iteration procedure is proposed and demonstrated for the case where the projected-angle form-function for anisotropic scattering is well-behaved. Extension to δ-form-functions, although not demonstrated, is in principle possible. J.W.Gardner

530.145

8400. ON THE RELATION BETWEEN SCATTERING PHASE AND BOUND STATES. J.M.Jauch.
Helv. phys. Acta, Vol. 30, No. 2-3, 143-56 (1957).

The relation between phase-shifts and bound states proved by Levinson for spherical symmetric potential functions satisfying certain regularity conditions is generalized for arbitrary interactions. The regularity condition of Levinson is replaced by a condition for the behaviour of the scattering state wave-functions at infinite energy. The proof of the relation given here shows that it is a simple consequence of the orthogonality and completeness relation for the eigenfunctions of the total energy operator. A.

530.145

8401. POSSIBLE FORMS OF NON LINEAR MESODYNAMICS. A.Borgardt.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 102-10 (Jan., 1957).

Some principles of construction of nonlinear equations of meson fields are considered. The wave equations obtained are more general than those of Schiff. Asymptotic solutions in static approximation at small distances are found in the case of pseudoscalar mesodynamics. The saturation condition for these nonlinear potentials is discussed. A.

530.145

8402. REMARKS ON THE FIXED EXTENDED SOURCE PION THEORY. H.Fukutome and Y.Nogami.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 347-55 (Feb., 1957).

Cini and Fubini's analysis (Abstr. 7146/1956) on the possibility whether the fixed extended source pion theory can reproduce the low energy experimental p-wave pion–nucleon scattering cross-sections is reinvestigated in the light of the restrictions: (i) The requirement that the probability cannot be negative imposes some restrictions on the expectation values of the operators τ_α, σ_1 and $\tau_\alpha\sigma_1$, and (ii) there is a geometrical limitation on the scattering cross-section. It becomes clear that, as far as the contribution to Cini and Fubini's sum rules from the high energy region (above cut-off) is small, the theory cannot reproduce the experimental scattering cross-sections, even for the low energy region (pion kinetic energy $\sim<$ 300 MeV). However, there is no reason to consider that the high energy contribution be small. On the other hand, it is almost certain that the theory can reproduce the experimental p-wave pion nucleon scattering cross-section for the low energy region. This implies that the high energy contribution to Cini and Fubini's sum rules is important and should not be neglected. A.

530.145

8403. STUDY OF THE NUMBER OF VIRTUAL MESONS ON A SIMPLE MODEL. E.Arnous.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 483-90 (Feb., 1957).
In French.

A well-known model is studied, where the nucleons are considered as fixed and extended sources interacting with a neutral scalar field. The exact wave-function of the ground state is computed and it is shown that the probability distribution of the number of virtual mesons is a Poisson distribution. The mean value of that number is computed as a function of the radius of the sources and of the distance between the nucleons. It is seen that this number of virtual mesons never exceeds one or two, for radii and distances of the order of 10^{-13} cm and values of $g^2/4\pi\hbar c$ of the order one. The above results seem to justify methods of the Tamm–Dancoff type. A.

530.145

8404. PHASE SHIFT ANALYSIS OF PROTON–PROTON SCATTERING EXPERIMENTS. II. ANALYSIS OF THE SCATTERING DATA FROM 18 TO 260 MeV. E.Clementel, C.Villi and L.Jess.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 907-20 (April, 1957).

For Pt I, see Abstr. 2667 (1956). The experimental data are discussed by using an analytical method and limiting the analysis to the contribution of the S and P states. The polarization data at high energy allow a double set of phase shifts which reproduce the angular distributions in the considered energy interval. The two sets follow from the behaviour of the singlet S phase shift, which can either become negative at about 220 MeV or be simply a decreasing function of the energy without assuming negative values. The stability of the solutions thus found against the introduction of the $^1D_2$ and $^3F_2$ states is also discussed. Finally, the results are compared with the solutions already obtained in proton–proton scattering analysis by other authors. A.

530.145

8405. A CLASSICAL CALCULATION OF THE NUCLEON–MESON COUPLING CONSTANT. G.Stephenson.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 1009-10 (April, 1957).

Using a certain limiting procedure a finite value is obtained for the ratio of the classical self-energies of the nucleon and electron. This ratio is put equal to the nucleon–electron rest-mass ratio and gives $g^2/\hbar c = 13.4$. G.Stephenson

530.145

8406. ON NEUTRON–PROTON SCATTERING.
E.Clementel and C.Villi.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1166-87 (May, 1957).

General expressions for the nucleon–nucleon elastic scattering cross-section and polarization are derived from the transition matrix up to the orbital angular momentum L = 3. A detailed investigation on the reliability of the approximation restricted to partial waves corresponding to $L \leq 2$ has been carried out. The charge independence of nuclear forces and the continuity of the phase-shifts versus neutron energy has been taken into account. It is shown that because of the change of sign of the singlet S phase-shift at about 220 MeV, following from the analysis of proton–proton data, the n–p differential cross-section at 260 MeV cannot be fitted in the lowest approximation without destroying either the continuity of the phase-shift solutions in the energy interval ranging from 27 to 260 MeV or the charge independence of nuclear forces, or both. It is also shown that the high energy n–p solutions cannot be continuously linked to the low energy ones if the S phase-shift for the singlet state is assumed positive throughout the considered energy interval. The effect of the $^3S_1$-$^3D_1$ coupling is discussed in detail at 95 MeV. A.

530.145

8407. CHARGE DEPENDENT CORRECTIONS TO DISPERSION RELATIONS. I. A.Agodi and M.Cini.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1256-65 (May, 1957).

The corrections to the forward dispersion relations for pion–nucleon scattering due to the mass difference between charged and neutral π-mesons are evaluated. Since the dispersion relations obtained from a relativistic theory have essentially the same form as those derived from a fixed source Hamiltonian with s and p waves, the calculation has been performed by introducing in the latter Hamiltonian the observed meson masses. The correction term to the dispersion relations is different for positive and negative mesons but turns out to be small. For mesons of momentum q of the order of the meson mass this gives a difference between the two cases which amounts to about 1% of f^2. A.

530.145

8408. DETERMINATION OF THE PION–NUCLEON INTERACTION COUPLING CONSTANT FROM SCATTERING EXPERIMENTS USING DISPERSION RELATIONS. G.Puppi and A.Stanghellini.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1305-14 (May, 1957).

The renormalized coupling constant of the pion–nucleon interaction has been calculated by fitting the experimental data of the scattering with the dispersion relations. For the $\pi^+ + p \rightarrow \pi^+ \rightarrow +p$, it was found that $f^2 = 0.095 \pm 0.005$ and the experimental data and the theory well consistent. For the $\pi^- + p \rightarrow \pi^- + p$, a coupling constant appreciably smaller was found. The fact is not understandable in the frame of the usual theory of the pion–nucleon interaction. A.

530.145

8409. LOW ENERGY K–NUCLEON INTERACTION.
D.Amati and B.Vitale.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1533-9 (June, 1957).

The low energy K–nucleon interaction has been studied using the Salam interaction Hamiltonian for the nucleon–heavy meson–hyperon system. The K–N scattering amplitude has been calculated disregarding $\bar{K}$ virtual state contributions, recoil and virtual barion–antibarion pair effects. Results are rather independent of the cut-off energy η. The experimental data on K^+–N scattering cross-sections are obtained with a renormalized coupling constant $G^2/4\pi = 0.3$. With this choice for the coupling constants, the phase-shifts are small and negative for the T = 0 isobaric spin eigenstate and rather larger and positive for the T = 1 eigenstate. A.

530.145

8410. LOW'S GENERAL EQUATION. W.Królikowski.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1611-21 (June, 1957).

Contains a derivation of a formally exact relation in the field theory between the elements of the S matrix corresponding to a given number of particles. This relation is similar in form to Low's equation (Abstr. 3453/1955), but all elements of the S matrix associated with different numbers of particles but one distinguished are here eliminated. The derivation of this relation is based on the equation for a distinguished component of the state vector corresponding to a given number of particles. Low's general equation obtained here contains the interaction operator of the given number of particles. So far, this operator can be evaluated practically only by expanding it in the coupling constant. A.

530.145

8411. ON THE RELATION BETWEEN THE LEE MODEL AND ORDINARY MESON THEORY. G.F.Dell'Antonio and F.Duimio.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1636-45 (June, 1957).

Some features of a possible generalization of the Lee model are examined. It is shown that it can be considered as an approximation of the neutral scalar meson theory with fixed sources, obtained by introducing a cut-off on the total energy of the mesons. A.

530.145

8412. CROSSING SYMMETRY AND THE RELATIVISTIC EQUATION FOR TWO FERMIONS. S.F.Edwards and P.T.Matthews.
Phil. Mag. (Eighth Ser.), Vol. 2, 831-8 (July, 1957).

A consideration of the symmetries of the scattering matrix of two fermions leads to the proposal of a linear scattering equation. This equation, unlike the ladder approximation, is shown to have all the symmetries and invariance properties of the true t matrix. In the limit of one of the fermions becoming indefinitely heavy the relation of this and the ladder approximations to the Dirac equation is discussed and it is shown how a covariant equation which reduces to the Dirac equation in the no-recoil can be formulated. A.

530.145

8413. REMARKS ON CROSSING SYMMETRY.
S.F.Edwards and P.T.Matthews.
Phil. Mag. (Eighth Ser.), Vol. 2, 839-44 (July, 1957).

Some relations between different partial wave amplitudes due to crossing symmetry are derived for meson–nucleon scattering and some similar symmetry properties for the nucleon–nucleon interaction. A.

530.145

8414. ACCURACY OF THE BORN APPROXIMATION IN NUCLEAR MANY-BODY THEORY. D.J.Thouless.
Phys. Rev., Vol. 107, No. 2, 559-62 (July 15, 1957).

Brueckner's equation for the reaction matrix in the many-body theory is solved for an S-state potential by an iterative process. The effective potential energy of a nucleon, and hence the binding energy, are calculated in the first order. When the second-order term is calculated, it is found that it is only a small correction which raises the binding energy from 16.9 MeV to 19.4 MeV per particle. No explanation of the saturation of nuclear forces at the known density can be given in this way. A.

530.145

8415. PROPERTIES OF THE FIXED-SOURCE MESON THEORY.
K.Tanaka.
Phys. Rev., Vol. 107, No. 2, 616-20 (July 15, 1957).

The renormalized p-wave coupling constant is determined from experiments in the following way. The ratio ρ_1 (ρ_2) of the matrix elements of the operator $\tau\cdot(\sigma\tau)$ between physical nucleon states and those between bare states is computed in terms of a renormalized p-wave coupling constant f^2 and a cutoff factor Ω, by solving a set of equations proposed by Ekstein (Abstr. 2990/1957). A sum rule in terms of ρ_1, ρ_2, f^2 and an integral over the phase shift δ_{33} is obtained from relations given by Cini and Fubini (Abstr. 4826/1956). Finally, by substituting ρ_1 and ρ_2 into the sum rule, one obtains f^2 in terms of Ω. The expectation values in the physical nucleon states, of the total number, total charge, and total energy of the mesons in the nucleon cloud and the self-energy of the physical nucleon are expressed as quotients of two power series in f^2. These quantities are then calculated as functions of f^2 and Ω without making use of the experimental data. Comparison with the essentially experimentally determined values of Fubini and Thirring supports the idea that the Chew model is in agreement with low-energy experimental data. A.

530.145

8416. UNIQUENESS OF SOLUTIONS TO DISPERSION RELATIONS FOR POTENTIAL SCATTERING. S.Gasiorowicz and M.A.Ruderman
Phys. Rev., Vol. 107, No. 3, 868-70 (Aug. 1, 1957).

Some properties of the dispersion relations for potential scattering are examined. It is shown that even for a potential of finite

extent, the dispersion and unitarity relations do not define a unique scattering amplitude, so that they do not contain all the information that is derivable from the Schrödinger equation. A.

530.145

8417. FORMULATION OF HIGH-ENERGY POTENTIAL SCATTERING PROBLEMS. D.S.Saxon.
Phys. Rev., Vol. 107, No. 3, 871-6 (Aug. 1, 1957).

A method is presented for treating high-energy potential scattering in which the zero-order result is essentially the W.K.B. approximation. The correction terms which appear involve the rate of change of the local wave-number and the curvature of the classical trajectory. Unlike the usual W.K.B. procedure which is only asymptotically correct, the formulation remains exact, but not necessarily convenient, even if the corrections are large. The improvement over the W.K.B. approximation is demonstrated explicitly for one-dimensional scattering and for the calculation of phase shifts for scattering from a central potential. It is also shown that this prescription reduces to the Born approximation when the conditions for the validity of that approximation are satisfied. Thus the proposed formulation contains both the W.K.B. and Born approximations as simple limiting cases. A.

530.145

8418. STATE SPACES IN SCATTERING THEORY. E.L.Hill.
Phys. Rev., Vol. 107, No. 3, 877-83 (Aug. 1, 1957).

Earlier work on the definition of state spaces for a particle in quantum-mechanical theory is extended to the case of scattering in a Coulomb field. The existence of the Fock–Bargmann symmetry group for this field leads to separability of the Schrödinger equation in parabolic coordinates, which in turn allows one to define the parabolic-wave state space for a particle. A discussion is given of the W.K.B. limit in scattering problems. A.

530.145

8419. CAN THE S-MATRIX BE GENERATED FROM ITS LOWEST-ORDER TERM? N.G.van Kampen.
Physica, Vol. 23, No. 2, 157-63 (Feb., 1957).

The suggestion that the S-matrix can be generated from its lowest-order term by successive applications of the unitarity and causality conditions, is tested on a simple example. It is shown that the procedure is vitiated by the breakdown of the expansion near resonance, which makes an application of the Kramers–Kronig relations to the separate terms impossible. In the case of propagation of waves through a medium the state of affairs is analogous. A.

530.145

8420. ELASTIC SCATTERING OF LOW ENERGY NUCLEONS BY COMPLEX NUCLEI. G.E.Brown and C.T.De Dominicis.
Proc. Phys. Soc. A, Vol. 70, Pt 9, 668-80 (Sept., 1957).

The relation of the complex well which is used to describe average features of the scattering to dispersion theory is discussed. A model is employed in which the compound states have an underlying single-particle structure. It is shown that a complex well can be defined which reproduces the average scattering phase. The imaginary part of this well is simply related to the absorption. A.

530.145

8421. RESONANCES IN A COMPLEX WELL. G.E.Brown.
Proc. Phys. Soc. A, Vol. 70, Pt 9, 681-5 (Sept., 1957).

The scattering in a complex well of the type used in optical model calculations is described by dispersion theory. The positions and widths of the resonances are found. A.

530.145

8422. DIRECT INTERACTION AND NUCLEAR DISPERSION THEORY. G.E.Brown and C.T.De Dominicis.
Proc. Phys. Soc. A, Vol. 70, Pt 9, 686-9 (Sept., 1957).

The problem of inelastic scattering of several MeV nucleons is formulated in nuclear dispersion theory. The case where the residual nucleus is left in a state of low excitation is considered in detail. Contributions from the distant compound-nucleus levels can be summed explicitly, and give an expression similar to that usually employed in the theory of direct interaction to calculate differential cross-sections. Contributions from the near compound-nucleus levels contribute in a complex fashion, and cannot explicitly be summed. It is assumed that phase relations can usually be neglected for them, and they, then, are responsible for the compound-inelastic scattering. A.

530.145

8423. SOLUTION OF THE SCHRÖDINGER EQUATION OF TWO-ELECTRON ATOMS. II. RIGOROUS METHOD. SYMMETRIC STATES. G.Munschy and P.Pluvinage.
J. Phys. Radium, Vol. 18, No. 3, 157-60 (March, 1957). In French.

For Pt I see Abstr. 1493 (1956). The Schrödinger equation of two-electron atoms is rigorously solved by a development in series of orthogonal functions. The method is here explained in the simplest case of the S symmetric states. A determinant can be constructed, the roots of which are $(-E)^{1/2}$. In contrast to the variation method, there is no variation of argument and the number of terms in each row or column is finite. A.

530.145

8424. RELATIVISTIC COVARIANCE ON THE BASIS OF QUANTUM MECHANICS. III. ADAPTATION OF VON NEUMANN'S THEORY TO OUR FORMALISM. THE PROBLEM OF MACROSCOPIC IRREVERSIBILITY. O.Costa de Beauregard.
J. Phys. Radium, Vol. 18, No. 4, 223 (April, 1957). In French.

For Pt II, see Abstr. 5880 (1957). The author's invariant and conservative definition of the Hermitian scalar product is able to suppress the dissymmetry between space and time in Von Neumann's collective formalism. The double aspect of Von Neumann's irreversibility theorem: equivalence between the two macroscopic principles of retarded waves and increasing entropy. Remarks on the physical interpretation of this twofold principle: simultaneous introduction of Minkowski's conceptions and of the cybernetic notion of information. A.

530.145 : 537.312.62

8425. INTERACTION BETWEEN WAVES AND ELECTRONS, WITH SOME REMARKS ON SUPERCONDUCTIVITY. L.Brillouin.
J. Phys. Radium, Vol. 18, No. 5, 331-6 (May, 1957). In French.

Discusses anew the interaction between an elastic wave and a free electron. Previous publications must be corrected to account completely for energy transfers. Such interactions must play a very important role in the theory of superconductivity (Bardeen, Fröhlich), but it is very doubtful whether they contain the complete answer. These interactions should occur for all metals at temperatures below the Debye temperature. A new unknown factor is needed to characterize superconductors, and explain their low temperatures and magnetic behaviour. It is suggested that exchange terms might provide the new factor required at this point. A.

530.145

8426. CONFORMALLY INVARIANT WAVE EQUATIONS FOR NON-LINEAR AND INTERACTING FIELDS. J.A.McLennan,Jr.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 640-7 (March, 1957).

Non-linear conformally invariant wave-equations for spinors of arbitrary rank are obtained. These include an equation recently proposed by Gürsey. In addition, conformally invariant equations for interacting fields are given. A.

530.145

8427. SEPARABILITY OF A COVARIANT WAVE EQUATION. H.S.Green.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 866-71 (April, 1957).

Separable solutions are obtained of a covariant wave-equation proposed by Wick, who conjectured that such solutions do not exist. The solutions are in a simpler form and more easily obtained than those obtained by Wick and Cutkosky, whose conclusions on the energy spectrum are, however, confirmed. The separability of the covariant wave-equation is shown to be connected with the existence of a constant of motion which does not appear in non-relativistic approximation, but is analogous to the "strangeness" or dionic quantum number which has already been proposed. A.

530.145

8428. IRREDUCIBLE REPRESENTATIONS OF THE FULL LORENTZ GROUP. V.Heine.
Phys. Rev., Vol. 107, No. 2, 620-3 (July 15, 1957).

All the irreducible representations of the full Lorentz group and its subgroups are derived and described. A.

530.145

8429. PERTURBATION THEORY OF LARGE QUANTUM SYSTEMS. N.M.Hugenholtz.
Physica, Vol. 23, No. 6, 481-532 (June, 1957).

The time-independent perturbation theory of quantum mechanics is studied for the case of very large systems, i.e. systems with large spatial dimensions (large volume Ω), and a large number of degrees of freedom. Examples of such systems are met with in the quantum theory of fields, solid state physics, the theory of imperfect gases and in the theory of nuclear matter. Only systems at or near the ground state (i.e., systems at zero temperature) are treated in this paper. In the application of the conventional perturbation theory to such large quantum systems one encounters difficulties which are connected with the fact that even small perturbations produce large changes of the energy and wave-function of the whole system. These difficulties manifest themselves through the occurrence of terms

containing arbitrarily high powers of the volume Ω in the perturbation expansion of physical quantities. An extremely bad convergence of the perturbation expansion is the result. For the analysis of the Ω-dependence of the terms in the expansion a new formulation of the time-independent perturbation theory is used, which was introduced by Van Hove. Making extensive use of diagrams to represent the different contributions to matrix elements it is possible to locate and separate the Ω-dependent terms, and to carry out partial summations in the original expansion. These separations and summations solve the above difficulties completely. Improved perturbation theoretical expressions are obtained for energies and wave-functions of stationary states, as well as for the life-times of metastable states. All terms in these expressions are, in the limit of large Ω, either independent of Ω or proportional to Ω, corresponding to intensive or extensive physical quantities. The convergence of the improved perturbation expansions is no longer affected by the large magnitude of Ω. A.

530.145

8430. THE DESCRIPTION OF COLLECTIVE MOTIONS IN TERMS OF MANY-BODY PERTURBATION THEORY. J.Hubbard.
Proc. Roy. Soc. A, Vol. 240, 539-60 (July 16, 1957).

It is shown how a theory equivalent to the Bohm and Pines collective motion theory of the electron plasma can be derived directly from a perturbation series which gives in principle an exact solution of the many-body problem. This result is attained by making use of a diagrammatic method of analysis of the perturbation series. By a process analogous to the elimination of photon self-energy parts from the electrodynamic S matrix it is found possible to simplify the perturbation series, introducing a modified interaction between the particles. A useful integral equation for this modified interaction can be set up and it is shown how the energy of the system can be expressed in terms of the modified interaction. The close connection between this approach and the dielectric theory of plasma oscillations is indicated. A.

530.145

8431. ON THE QUANTUM THEORY OF MEASUREMENT.
P.K.Feyerabend.
Z. Phys., Vol. 148, No. 5, 551-9 (1957). In German.

Contains a discussion of the assumption of "quantum-jumps" in the form in which it has been presented by Heisenberg and von Neumann, as well as of the difficulties to which this assumption leads, when incorporated into the theory of measurement. It is shown that these difficulties are due to the incompleteness of that theory. An attempt is made to outline a complete theory which contains, apart from the equations of motion, three plausible assumptions, but which does not contain any "quantum-jumps". A.

530.15

8432. ON THE THEORY OF RELAXATION PROCESSES.
A.G.Redfield.
I.B.M. J. Res. Developm., Vol. 1, No. 1, 19-31 (Jan., 1957).

A general procedure is given for finding the equation of motion of the density matrix of a system in contact with a thermal bath, as for example a nuclear spin system weakly coupled to a crystal lattice. The thermal bath is treated both classically and quantum mechanically, and the theory is similar to, and and a generalization of, conventional theories of time-proportional transition probabilities. Relaxation of the system by the thermal bath is expressed by a linear matrix operator, and it is stressed that elements of this operator can be regarded as secular or non-secular perturbations on the equation of motion and can be treated accordingly. When the motion of the system is slow compared to that of the thermal bath, the equation of motion can be expressed in an operator form which is independent of representation. If the system has a time-dependent Hamiltonian which varies slowly compared to the motion of the thermal bath, the same equation of motion is obeyed and the system is relaxed by the bath toward a Boltzmann distribution with respect to its instantaneous Hamiltonian. If the time variation of the Hamiltonian is more rapid, higher order corrections to the operation of motion must be applied. The theory is applied to spin—lattice relaxation of a coupled nuclear spin system in a metal, for arbitrary externally applied fixed magnetic field. A.

530.161

8433. REMARKS CONCERNING THE FUNDAMENTAL HYPOTHESIS OF THE THEORY OF IRREVERSIBLE PROCESSES DUE TO K.POPOFF. A.Péneloux.
C.R. Acad. Sci. (Paris), Vol. 244, No. 21, 2589-91 (May 20, 1957). In French.

It is shown that the theory of Popoff (Mémorial des Sciences Physiques, No. 63, 1956) gives ridiculous results when applied to the case of a simple pendulum oscillating in a viscous fluid.

R.O.Davies

530.161

8434. NORMALIZATION OF INTENSITY CURVE IN THE METHOD OF RADIAL DISTRIBUTION. B.K.Vaĭnshteĭn.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 4, 640-3 (1957). In Russian.

Since the normalization based on the condition

$$I_n(s) \approx \sum_{i=1}^{n} f_i^2(s),$$

where $I_n(s)$ is the intensity of scattering by a group of n atoms, and $f_i(s)$ is the atomic factor of scattering, can lead to considerable errors, the author advocates using the whole I(s) and develops the equation

$$\int_0^\infty I_n(s)s^2ds = \sum_{i=1}^{n} \int_0^\infty f_i^2(s)s^2ds$$

Its physical meaning is that the interference occurring at a certain mutual arrangement of the atoms cannot alter the total intensity of (the coherent) scattering produced by these atoms, but only causes a redistribution of intensity. An appropriate method of normalization (in which the right-hand side of the above equation becomes a relatively simple function of the atomic number) is developed, and so is an equation in which allowance is made for the incoherent scattering. It is stressed that, when dealing with a number of structural models of molecules of gases or vapours, the criterion of the best model is the minimum value of the expression $\int (I_{n\,\text{exper}} - I_{n\,\text{calcul}})s^2ds$. The results are applicable to X-ray, electron and neutron diffraction. F.Lachman

530.162

8435. CALCULATION OF TIME CORRELATION FUNCTIONS FOR STATISTICAL SYSTEMS WITH ACTION-AT-A-DISTANCE FOR ANY TIME UP TO FREE-PATH TIME. V.V.Tolmachev.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 2, 301-4 (1957). In Russian.

Develops a statistical mechanics for an ensemble with generalized interactions between particles. The effect of the resulting correlations on the macroscopic properties of the ensemble is investigated. J.W.Gardner

530.162

8436. APPLICATION OF THE SERIES METHOD OF IMPERFECT GAS THEORY TO OTHER PROBLEMS IN STATISTICAL MECHANICS. T.L.Hill.
J. chem. Phys., Vol. 27, No. 2, 561-4 (Aug., 1957).

Certain well-known series expansions have proved very useful in imperfect gas theory. Series formally identical with those of imperfect gas theory can also be developed in other, quite unrelated, problems in statistical mechanics. Criteria for the existence of this formal analogy and examples are discussed. A.

530.162

8437. STATISTICAL-MECHANICAL THEORY OF IRREVERSIBLE PROCESSES. I. GENERAL THEORY AND SIMPLE APPLICATIONS TO MAGNETIC AND CONDUCTION PROBLEMS. R.Kubo.
J. Phys. Soc. Japan, Vol. 12, No. 6, 570-86 (June, 1957).

A general type of fluctuation-dissipation theorem is discussed to show that the physical quantities such as complex susceptibility of magnetic or electric polarization and complex conductivity for electric conduction are rigorously expressed in terms of time-fluctuation of dynamical variables associated with such irreversible processes. This is a generalization of statistical mechanics which affords exact formulation as the basis of calculation of such irreversible quantities from atomistic theory. The general formalism of this statistical-mechanical theory is examined in detail. The response, relaxation, and correlation functions are defined in quantum-mechanical way and their relations are investigated. The formalism is illustrated by simple examples of magnetic and conduction problems. Certain sum rules are discussed for these examples. Finally it is pointed out that this theory may be looked upon as a generalization of the Einstein relation. A.

530.162

8438. ON THE STATISTICAL BASIS OF ONSAGER'S RECIPROCAL RELATIONS. S.R.de Groot and P.Mazur.
Physica, Vol. 23, No. 1, 73-81 (Jan., 1957).

A survey and discussion is given of various derivations of the

Onsager reciprocal relations between irreversible processes. In particular a derivation is presented dealing explicitly with non-equilibrium situations. A.

530.162

8439. ON KRAMERS' GENERAL THEORY OF BROWNIAN MOTION. H.C.Brinkman.
Physica, Vol. 23, No. 1, 82-8 (Jan., 1957).

Kramers' general theory of Brownian motion based on a diffusion equation in phase space is discussed from the standpoint of statistical thermodynamics. It is concluded that for particles moving in a medium in equilibrium the restrictions imposed by the second law of thermodynamics limit Kramers' diffusion equation to a slight generalization of Einstein's theory of Brownian motion. A.

530.162

8440. THE APPROACH TO EQUILIBRIUM IN QUANTUM STATISTICS. L.van Hove.
Physica, Vol. 23, No. 6, 441-80 (June, 1957).

The approach of a quantum system to statistical equilibrium under the influence of a perturbation is described by a well known transport equation, now often called master equation. This equation holds only when the perturbation is taken into account to lowest non-vanishing order. It has been stressed in a recent paper that certain characteristic properties of the perturbation, easily seen to hold for actual systems (crystals, gases), play an essential role in determining the irreversible nature of the effects described. On the basis of these properties it was possible to derive the lowest order master equation from the Schrödinger equation by making one assumption only, relative to the phases of the wave-function at the initial time. In contrast with the usual derivation which assumes the phases to be random at all times, the method just mentioned is capable of extension to higher orders in the perturbation. This extension is carried out in the present paper. The essential results are the establishment of a generalized master equation valid to arbitrary order in the perturbation, and the proof that the long time behaviour of its solution corresponds to establishment of microcanonical equilibrium (the latter being taken for the total Hamiltonian, perturbation included). The generalized master equation exhibits with its lowest order version the essential difference that it corresponds to a non-Markovian process. The transition from the exact master equation to its lowest order approximation is discussed in detail. It illustrates the existence of two time scales, a short one and a long one, for very slow irreversible processes, as well as their overlapping in the case of faster processes. A.

530.162

8441. ON THE MOLECULAR THEORY OF THE BROWNIAN MOVEMENT. I.Prigogine and R.Balescu.
Physica, Vol. 23, No. 6, 555-68 (June, 1957). In French.

It is well known that the usual theory of Brownian motion has a strictly phenomenological character. The equilibrium distribution is postulated but not derived, as is also the special stochastic process which permits the system to reach equilibrium. Following on recent work it is possible to go much further for a class of dynamical systems called "weakly coupled" systems. If for systems of this kind spatial homogeneity is assumed the evolution is described by a partial differential equation of the first order in time and of the second order in the action variables of the system. However, owing to the large number of independent variables, it is not easy to discuss in detail the solution of such an equation. For this reason special situations corresponding to the evolution of a single degree of freedom out of equilibrium are studied in detail. For such systems it is then possible to derive a theory of Brownian motion starting from first principles. Two cases are studied in detail: weakly coupled oscillators like in slightly anharmonic solids or in radiation theory and gases interacting through weak long range forces (i.e. gravitational or electrostatic). In the first case it is possible to solve completely the problem while the results obtained in the second are not so exhaustive. It is shown that the approach to equilibrium is governed by non-Gaussian Markoffian processes. In the second example the well known results obtained by Chandrasekhar on dynamical friction are easily obtained by this method. A.

530.162 : 518.5

8442. AN ANALOGUE METHOD FOR STUDYING MULTIPLE SCATTERING. J.C.Barton, D.A.Campbell and R.C.Read.
Proc. Phys. Soc. A, Vol. 70, Pt 8, 605-14 (Aug., 1957).

A source of random motion was coupled to a mechanical differential analyser so that the output simulated the behaviour of a high-energy charged particle undergoing multiple scattering. A large number of track analogues were drawn and their statistical behaviour studied. They provided an experimental test of the theory for the first passage problem of multiple scattering. A.

GENERAL MECHANICS. MECHANICS OF SOLIDS 531

531.259 : 548.0

8443. THERMAL STRESSES IN CUBIC CRYSTALS. B.N.Grechushnikov and D.Brodovskiĭ.
Kristallografiya, Vol. 1, No. 5, 597-9 (1956). In Russian.

Theoretical. The basic general equations are set up and applied to the problem of thermal stresses in a cylinder of material possessing cubic symmetry. R.F.S.Hearmon

531.259 : 548.0

8444. THERMOELASTIC STRESSES IN ANISOTROPIC PLATES. V.L.Indenbom, I.M.Sil'vestrova and Yu.I.Sirotin.
Kristallografiya, Vol. 1, No. 5, 599-603 (1956). In Russian.

A formula is obtained for thermal stress in terms of temperature, position, and the thermoelastic coefficients, β_{ik}, which are functions of the elastic compliances and thermal expansion coefficients of the material. Expressions for the β_{ik} are tabulated, corresponding to the X, Y and Z axes in all crystal systems except the triclinic. Some numerical results are given for ethylene diamine tartrate. R.F.S.Hearmon

531.259 : 548.0

8445. THERMAL STRESSES ARISING ON THE HEATING AND COOLING OF MONOCRYSTALS. Yu.I.Sirotin.
Kristallografiya, Vol. 1, No. 6, 708-17 (1956). In Russian.

A derivation is given of the thermal stresses arising in anisotropic plates and elliptic cylinders, and in spheres of cubic symmetry on heating or cooling at constant rate (see also two preceding abstracts). R.F.S.Hearmon

531.578

8446. PENETRATION BY HIGH-SPEED METALLIC JETS. S.Singh.
Proc. Phys. Soc. B, Vol. 70, Pt 9, 867-79 (Sept., 1957).

This paper presents an attempt to correlate theoretically the various phenomena relating to jet formation and penetration into metallic targets by lined cavity charges (cf. Abstr. 3117/1948, 111/1956) on the basis of a simple modification of the non-steady state hydrodynamic theory. The modification consists in adding to the theory a couple of new assumptions suggested by experimental results and it appears that this modified theory accounts adequately for the stretching of the jet as it travels in space, the break-up of the jet into the particles, the waver of the jet and the strength of the jet and target materials. In order to check the theory, numerical evaluations have been carried out in case of standard M9A1 steel cones for which experimental results of Eichelberger (Abstr. 5251/1955, 6413/1956) are available. The good quantitative agreement between the published experimental values of Eichelberger and the theoretical results show that the theory provides an accurate description of the variation of depth, velocity and time of penetration with stand-off and nature of target material. A.

MECHANICAL MEASUREMENTS 531.7

531.787.2 : 537.542

BUBBLE CHAMBER PRESSURE GAUGE. See Abstr. 7984

MECHANICS OF FLUIDS 532

532.57 : 621.317.79

8447. A NOTE ON ELECTROMAGNETIC FLOWMETERS OF RECTANGULAR CROSS-SECTION. H.W.Holdaway.
Helv. phys. Acta, Vol. 30, No. 1, 85-8 (1957).

It is demonstrated that, for two-dimensional flow distributions in a conduit subject to a uniform transverse magnetic field, the e.m.f. generated between two opposite conducting faces of the rectangular cross-section is proportional to the true average velocity of flow, irrespective of the nature of the two-dimensional distribution. The form of analysis employed permits an examination also of the effect of internal resistance of the unit when connected to an external measuring circuit. A.

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

8448. A CELL-CLUSTER THEORY FOR THE LIQUID STATE. III. THE HARMONIC OSCILLATOR MODEL.
E.G.D.Cohen, J.de Boer and Z.W.Salsburg.
Physica, Vol. 23, No. 5, 389-403 (May, 1957).

The cell-cluster theory developed in Pt I and II (Abstr. 9465-6/1955) is applied to the case where the total intermolecular potential field can be approximated by a harmonic potential field. This model can be applied to the solid state as well as to the liquid state and gives an improvement on the single cell (Einstein) theory of the condensed phase in the direction of the results of an exact treatment. Already the first cell-cluster approximation accounts for about 50% of the entropy difference between the single cell- and the exact theory. A.

532.7

8449. CELL-CLUSTER THEORY OF THE LIQUID STATE. IV. A FLUID OF HARD SPHERES.
Z.W.Salsburg, E.G.D.Cohen, B.C.Rethmeier and J.de Boer.
Physica, Vol. 23, No. 5, 407-22 (May, 1957).

The cell-cluster theory (preceding abstract) is applied to a fluid of hard elastic spheres. The corrections introduced by considering cell-clusters of two cells are investigated. The double cell partition function is calculated in an approximate way and the influence on the entropy and the equation of state is studied. The results of the cell-cluster theory for the equation of state are compared with the recent Monte Carlo calculations for a hard sphere fluid by Rosenbluth and Rosenbluth. A.

532.7

8450. THE CELL THEORY OF LIQUIDS. III. FUSION.
J.A.Barker.
Proc. Roy. Soc. A, Vol. 240, 265-73 (May 21, 1957).

For Pt II, see Abstr. 8026 (1956). Correlation effects in liquids at high densities and solids are investigated. Convergence of the "correlation expansion" of the phase integral is tested for a "harmonic force" model, and found to be very satisfactory. The binary correlation correction for the 12-6 potential at the temperature $kT/\epsilon = 0.75$ is evaluated approximately, and shown to give rise to a concave region in the curve of free energy against volume, indicating the existence of two condensed phases. For this temperature the pressure at which the two phases are in equilibrium is negative, i.e. the solid phase is more stable at zero pressure. An approximate extrapolation indicates that the zero pressure freezing-point is about $kT_F/\epsilon = 0.90$, somewhat higher than the value 0.70 observed for argon. The most likely of several possible explanations of the discrepancy is the effect of non-additive interactions in reducing the cohesion of solid argon. The calculated properties of the liquid are in better agreement with observed values for argon than those calculated neglecting correlations. A.

532.72

8451. CONCENTRATION DEPENDENCE OF DIFFUSION COEFFICIENT: ANALYSIS OF SKEWED DIFFUSION CURVE.
Y.Nishijima and G.Oster.
J. chem. Phys., Vol. 27, No. 1, 269-70 (July, 1957).

Skewed diffusion curves are analytically treated in terms of the Gram–Charlier expansion applied to the Boltzmann equation. The concentration dependence of the diffusion coefficients can be expressed in terms of moments of the diffusion curves. When the diffusion coefficient is linearly dependent on concentration, the slope is expressed in terms of three parameters of the diffusion curve, namely: (1) the third moment, (2) the height at the initial boundary, and (3) the average diffusion coefficient. A.

532.74 : 541.66

8452. SOME PROPERTIES OF LIQUID SULFUR AND THE OCCURRENCE OF LONG CHAIN MOLECULES. J.Schenk.
Physica, Vol. 23, No. 4, 325-37 (April, 1957).

Some properties of liquid sulphur, especially the viscosity, show an abrupt change at 160°C which is attributed to a change of ring molecules S_8 into very long chain molecules S_n. Data from the author's own experiments and literature are discussed from this point of view. They mostly confirm and never really contradict the chain hypothesis. Some phenomena, like the formation of chain sulphur from the vapour phase, seem to point to the existence of other kinds of unstable small molecules that transform easily to chain sulphur. This chain sulphur in itself is rather stable and at room temperature takes many days or even years to transform completely into rhombic sulphur. A.

532.74 : 541.66

8453. ON THE MOLECULAR CONSTITUTION OF LIQUID AND AMORPHOUS SULFUR. J.Schenk.
Physica, Vol. 23, No. 6, 546-50 (June, 1957).

The occurrence of ring molecules S_8 and long chain molecules S_n in liquid and amorphous sulphur is reasonably certain. Starting from the behaviour of amorphous sulphur, especially with regard to extraction with carbon disulphide, arguments are discussed for the presence in small amounts (order of 5%) of other molecular constituents. The facts may be explained by assuming these to be small unstable molecules S_π that transform slowly into chain sulphur at room temperature in the solid crystalline and plastic amorphous state. There is little evidence for their exact constitution, though in some cases the evidence points to S_8 rings. Most facts may, however, also be explained by assuming that these small molecules are not a priori present but that they are split off from the long chains by the attack of the solvent during the extraction process. A.

MECHANICS OF GASES 533

533.15

8454. NEW METHOD OF MEASURING DIFFUSION COEFFICIENTS OF GASES. A.A.Westenberg and R.E.Walker.
J. chem. Phys., Vol. 26, No. 6, 1753-4 (June, 1957).

At constant temperature and pressure a tracer gas is injected steadily from a point source into a laminar flow of a second gas having a uniform velocity. The mole fraction of the tracer gas at any given point can be calculated from the injection rate, the diffusion coefficient, the total molar density and the geometry of the system. Experimental values of the diffusion coefficient obtained for three gas pairs at room temperature and atmospheric pressure show good agreement with accepted values. The precision is about ±2%. H.C.Cole

533.16

8455. THE VISCOSITY OF CARBON DIOXIDE BETWEEN 0°C AND 75°C AND AT PRESSURES UP TO 2000 ATMOSPHERES.
A.Michels, A.Botzen and W.Schuurman.
Physica, Vol. 23, No. 2, 95-102 (Feb., 1957).

The viscosity was measured by a transpiration method. Previous measurements revealed an unexpected increase of the thermal conductivity of argon round the critical density. Therefore special attention has been given to the critical region although the transpiration method is not particularly suitable for this region. The viscosity of CO_2 above 40°C shows the normal trend with pressure, but deviates considerably from Enskog's theory. In the critical region the viscosity shows a similar abnormal behaviour as found for the heat conductivity of argon. Viscosity measurements of argon did not show this effect but in this case the temperatures relative to the critical temperature were higher than in the present measurements of CO_2. The results are compared with those of other authors. A.

533.21

8456. COMPRESSIBILITY OF GASES. III. THE SECOND AND THIRD VIRIAL COEFFICIENTS OF MIXTURES OF HELIUM AND NITROGEN AT 30°. G.M.Kramer and J.G.Miller.
J. phys. Chem., Vol. 61, No. 6, 785-8 (June, 1957).

For Pt I, see Abstr. 4425 (1955). The Burnett experiment has been used to obtain both the second and third virial coefficients of mixtures of helium and nitrogen at 30°. These mixture values have been used to compute the second virial coefficients (pure gas and interaction) as well as the third virial coefficients, C_{He}, $C_{He-He-N_2}$, $C_{He-N_2-N_2}$, and C_{N_2}. A.

533.5

8457. A NEW TYPE OF IONIZATION-PUMP.
G.Comsa and G.Musa.
J. sci. Instrum., Vol. 34, No. 7, 291-2 (July, 1957).

Previously, the Bayard–Alpert ionization gauge has been used as a pump to maintain low pressures in experiments where low pumping speeds (0.03 litres/sec) were adequate. In the new ionization pump developed by the authors, the glass wall of the vessel itself is used as the ion collector. The other electrodes consist of a hairpin filament surrounded by a spiral grid. The pumping speed is thereby improved by a factor of ten. Care must be taken to outgas the electrodes. The new pump cannot be used to measure pressures T.Mulvey

533.6.011

8458. A CENTRIPETAL-PUMP EFFECT IN AIR. M.Reiner.
Proc. Roy. Soc. A, Vol. 240, 173-88 (May 21, 1957).

An instrumental arrangement is described which constitutes a centripetal air-pump. It consists of a hollow cylinder closed at the top and open at the bottom which can be brought into rotation at high speeds about a vertical axis. When a receptacle filled with a heavy oil is lifted until the cylinder is partially immersed, the oil does not wet the cylinder, but an air-gap is maintained between the walls of the cylinder and the oil. It can be seen that air is pumped from the outer atmosphere through this gap into the cylinder. This presupposes that the air must be in a state of stress which includes elastic cross-stresses. It is shown that these stresses result from a stress-strain relation in which the strain is defined in Hencky's logarithmic measure. This confirms Maxwell's theory that air is an elastico-viscous material possessing an elastic shear modulus, and therefore a finite time of relaxation. A rheological equation for air is proposed accordingly. A.

MOLECULAR THEORY OF GASES 533.7

533.7

8459. EQUATIONS FOR A LATTICE GAS. II. MULTI-COMPONENT SYSTEMS. H.B.Levine.
J. chem. Phys., Vol. 27, No. 2, 335-42 (Aug., 1957).

For Pt I see Abstr. 5929 (1957). An expression is developed for P/kT for a multicomponent lattice gas with an arbitrary lattice as a multiple power series in a set of kth nearest-neighbour interaction parameters, $\lambda_{ab}{}^{k}$, where a and b index the components, with the coefficients functions of the activity set z. By straightforward differentiation, corresponding expressions are obtained for other thermodynamic variables, and also for the probability of finding a pair of particles of specified components on a pair of specified sites. A transformation is outlined which permits the substitution of the number density set ρ for the activity set as independent variables. A.

533.7 : 533.15

8460. INDIVIDUALIZATION OF MATTER IN DIFFUSION PHENOMENA. C.Bory.
J. Phys. Radium, Vol. 18, No. 4, 228-32 (April, 1957). In French.

Maxwell's molecular theory of the viscosity and thermal conductivity of a gas supposes a discontinuous medium. To extend this theory to turbulent flow, it is translated into the terms and the ideas of a continuous fluid structure. For this, a new class of geometrical transformations, called "diffuse transformations", must be introduced. A function is introduced, which must verify a certain integral equation, because the motion of flowing matter can be followed in terms of time. The same integral equation is again found for the repartition function, even when the idea of continuous structure is given up, and the fluid considered as constituted of particles. The meaning is studied of a repartition function not verifying the integral equation: what evolves would not, in this case, be individualizable. The idea of the impossibility of individualization in some circumstances is thus derived from considerations quite different from the usual ones. A.

533.7

8461. GEOMETRICAL THEORY OF CONVEX MOLECULES IN NON-UNIFORM GASES. T.Kihara.
J. Phys. Soc. Japan, Vol. 12, No. 6, 564-9 (June, 1957).

The geometrical theory of convex molecules in uniform gases (Abstr. 4251/1956) is generalized to that in non-uniform gases when molecules are represented by rigid convex bodies without any additional intermolecular force. For this representation collisions between heavy molecules and light spherical molecules are treated exactly. Shape and size of several molecules are determined from the diffusion coefficient. A "geometrical approximation" is suggested for more general cases. A.

533.7

8462. FOKKER–PLANCK EQUATION FOR AN INVERSE-SQUARE FORCE. M.N.Rosenbluth, W.M.MacDonald and D.L.Judd.
Phys. Rev., Vol. 107, No. 1, 1-6 (July 1, 1957).

The contribution to the Fokker–Planck equation for the distribution function for gases, due to particle–particle interactions in which the fundamental two-body force obeys an inverse square law, is investigated. The coefficients in the equation, $\langle \Delta v \rangle$ (the average change in velocity in a short time) and $\langle \Delta v \Delta v \rangle$, are obtained in terms of two fundamental integrals which are dependent on the distribution function itself. The transformation of the equation to polar coordinates in a case of axial symmetry is carried out. By expanding the distribution function in Legendre functions of the angle, the equation is cast into the form of an infinite set of one-dimensional coupled nonlinear integro-differential equations. If the distribution function is approximated by a finite series, the resultant Fokker–Planck equations may be treated numerically using a computing machine. Keeping only one or two terms in the series corresponds to the approximations of Chandrasekhar, and Cohen, Spitzer and McRoutly, respectively. A.

533.7

8463. DETERMINATION OF THE SECOND VIRIAL COEFFICIENT B_{12} OF GAS MIXTURES.
J.Reuss and J.J.M.Beenakker.
Physica, Vol. 22, No. 10, 869-79 (Oct., 1956). In German.

A method is developed to determine the second virial coefficient in the equation of state of binary mixtures from experiments on the influence of pressure on the vapour–solid equilibrium of one of the components. The experiments of Dokoupil, Van Soest and Swenker on the systems H_2–N_2 and H_2–CO are discussed and compared with calculations based on a Lennard-Jones 12-6 potential for the interaction between unlike molecules. In these calculations the influence of quantum-mechanical effects is taken into account. In both cases good agreement with experiment is found. It was possible to make an estimation of the third virial coefficient in the case of H_2–N_2. For CO, values are given for the vapour pressure between 36 and 60°K. Finally, simple expressions are derived for the optimal pressure for purification purposes. A.

533.7

8464. ON THE EXISTENCE OF A BOUND STATE IN NEON.
D.ter Haar, W.M.Nicol and M.P.Barnett.
Physica, Vol. 22, No. 10, 911-14 (Oct., 1956).

A Lennard-Jones and an "exp-6" potential function for neon are investigated for the possible existence of a bound state of a neon molecule, by a method used by de Boer in the case of helium. It is concluded that there exists a bound state with an energy of about 5×10^{-5} atomic units ($\cong$ 0.002 eV). A.

533.7

8465. GENERALISED RELATIONS FOR THE THREE ELEMENTARY TRANSPORT COEFFICIENTS OF INERT GASES.
S.C.Saxena.
Physica, Vol. 22, No. 12, 1242-6 (Dec., 1956).

Utilizing the unique dependence of the two potential parameters of the Lennard-Jones 12:6 model on the molecular mass for inert gases, generalized relations have been developed for the three elementary transport coefficients. These formulae have been used to estimate the properties of radon, which are found to be in good agreement with the computed theoretical values. A similar mass dependence of the potential parameters is also shown here to hold for another set of elements, having similar electronic configuration, namely halogens. A.

533.7

8466. THE DISPERSION EQUATION FOR PLASMA WAVES.
N.G.van Kampen.
Physica, Vol. 23, No. 7, 641-50 (July, 1957).

Different opinions concerning the correct form, and the very existence, of the dispersion equation for waves in plasmas have appeared in the literature. The origin of these differences is discussed. A.

VIBRATIONS. ACOUSTICS 534

534.121 : 621.372.41

8467. THE CALCULATION OF THE RESONANCE FREQUENCIES OF RADIAL OSCILLATIONS OF CIRCULAR DISKS AND RINGS.
E.Tränkle.
Frequenz, Vol. 11, No. 5, 142-5 (May, 1957). In German.

The theory of elasticity yields equations for the radial and tangential forces in terms of extensions and the elastic modulus. Expressions are derived from these for the resonant frequencies. These involve the roots of a transcendental equation containing Bessel function terms. L.S.Goddard

534.143 : 535.43

8468. EXCITATION OF ULTRASONIC FREQUENCY VIBRATIONS IN QUARTZ. K.N.Baranskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 3, 517-19 (1957). In Russian.

Using a coaxial resonator to generate high harmonics in thick quartz plates, very high frequencies ($\sim 10^9$ c/s) are obtained. The diffraction of light by quartz vibrating in these modes in studied and compared with the theory of Rytov (1935). R.F.S.Hearmon

534.2 : 539.32

8469. VELOCITY OF ELASTIC WAVES AND INTERNAL FRICTION IN POLYMETHYL METHACRYLATE. L.Verdini.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 648-58 (March, 1957). In Italian.

By means of a dynamical method, the velocity of elastic extensional waves as well as internal friction, have been measured on polymethyl-methacrylate bars, in a temperature range from 20° C to 100° C. Bars of rectangular cross-section having a flexural natural frequency between 580 and 750 c/s were employed. The transition temperature of the polymer has been detected from the velocity v. temperature and damping v. temperature curves. At the transition point, the damping curves show an anomalous horizontal behaviour and in the velocity curves a sudden change in the temperature coefficient is observed. The specimens were annealed at different temperatures, and as a consequence of these heat treatments, a series of transition temperatures between 52° C and 63° C was found. It may be observed that below the transition point, internal friction increases exponentially with temperature, in agreement with the results obtained in pure metals and alloys. This behaviour seems to agree with a theory due to W.P.Mason, who has shown that the exponential increase of internal friction in solids is due to the breakways of the dislocations from their impurity pinning points, as a consequence of thermal agitation. A.

534.22/.23 : 541.124

DISPERSION AND ABSORPTION OF SOUND IN LIQUIDS IN GENERAL CHEMICAL EQUILIBRIUM. See Abstr. 8232

534.22 : 536.48

8470. MEASUREMENTS ON THE VELOCITY OF ULTRASONIC WAVES IN HELIUM AT 1° K WITH DIFFERENT FREQUENCIES.
A.van Itterbeek, G.Forrez and M.Teirlinck.
Physica, Vol. 23, No. 1, 63-4 (Jan., 1957).

Measurements are carried out on the velocity of sound in liquid helium at the neighbourhood of 1° K, with frequencies 200, 500, 600, 800 and 1500 kMc/s. A small minimum is observed for the velocity as a function of frequency, which does not appear at the boiling point. A.

534.22 : 541.64

8471. TEMPERATURE DEPENDENCE OF ULTRASONIC VELOCITY IN PLASTICS. G.S.Verma and S.K.Kor.
Physica, Vol. 23, No. 4, 306-8 (April, 1957).

Temperature coefficients of ultrasonic velocity as well as the expansion coefficients in polymeric materials such as Mouldrite, Perspex, polystyrene and Styron have been determined. The transition temperatures in both the cases are nearly the same. The ratio of the values of the expansion coefficient and the ratio of the slopes of the velocity–temperature curves taken above and below the transition temperature are almost same. A.

534.221

8472. THE VELOCITY OF SOUND IN METALS AT HIGH TEMPERATURES. J.F.W.Bell.
Phil. Mag. (Eighth Ser.), Vol. 2, 1113-20 (Sept., 1957).

A pulse method of measuring the velocity of sound in thin rods over a wide temperature range, in some cases to the melting point, has been developed. The results of measurements on aluminium, brass, nickel, iron, lead, solder and thallium show that, in the strain free condition, the method is a sensitive indication of physical and structural changes. The changes associated with the onset of a liquid phase, the Curie point, order–disorder and other structural changes are described. A.

534.222.2 : 531.768

8473. SHOCK SPECTRUM AS A CRITERION OF SEVERITY OF SHOCK IMPULSES. C.T.Morrow.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 596-602 (May, 1957).

Shock impulses have not as yet yielded to any practical method of spectral analysis that would permit convenient exact calculation of all the peak internal responses of hardware subject to such accelerations, and also permit comparison of shock severities by inspection. The shock spectrum with a few supplementary techniques, provides adequate insight into the responses of a one degree of freedom resonator. As an indication of the responses of a system with several coupled degrees of freedom, a second-order shock spectrum is defined. An oscillatory constituent of the spectrum is also defined in such a way as to be applicable to any order of spectrum. Investigation of these two concepts leads to the conclusion that if the first-order shock spectrum technique is to be used as a basis for the severity of a laboratory test shock with that of a service shock, spectra should be plotted for both positive and negative directions. Moreover, when feasible, such spectra should ordinarily be plotted as distinct curves for the intervals during and after the test shock, and the oscillatory constituent for the interval during the shock should be estimated. A.

534.23

8474. SOUND ABSORPTION ON PHASE TRANSITION IN ROCHELLE SALT.
I.A.Yakovlev, T.S.Velichkina and K.N.Baranskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 935-6 (1957). In Russian.

Ultrasonic pulses of frequency 5 Mc/s and polarized along the y-axis were propagated along the z-axis of a Rochelle salt plate. The sound absorption coefficient was measured as a function of temperature and found to be a maximum near the upper Curie point. R.F.S.Hearmon

534.232 : 621.395.623.7

8475. EFFECT OF A NEGATIVE IMPEDANCE SOURCE ON LOUDSPEAKER PERFORMANCE. R.E.Werner.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 335-41 (March, 1957).

A direct radiatior moving-coil loudspeaker driven by an amplifier whose output impedance approaches the negative of the blocked voice-coil impedance can be made to exhibit extended low-frequency response with reduced distortion. The effect of the system is in some ways analogous to a manyfold increase in loudspeaker efficiency. In a typical case, neutralization of 70% of the blocked voice-coil impedance completely damps the cone resonance, as well as substantially reducing the nonlinear distortion below resonance. When the amplifier is compensated for the falling radiation resistance at low frequencies, uniform output can be obtained to any arbitrary low frequency, limited only by the ultimate power-handling capability of the amplifier and speaker. In this system, no additional amplifier power is required at frequencies down to the speaker resonance; additional power is required below that point. A.

534.232

8476. RESEARCH ON THE ACOUSTIC AIR-JET GENERATOR: A NEW DEVELOPMENT. E.Brun and R.M.G.Boucher.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 573-83 (May, 1957).

The structure and operation of the Hartmann air-jet ultrasonic generator is reviewed critically, and modifications are described which substantially increase the efficiency and available power output of the original device. Experimental results are presented in confirmation of the theoretical analysis. An important part of the development has been the employment of a secondary resonator and projecting exponential horn. A novel design using a large number of whistles in a single horn is described. This unit has a wide frequency and power range, and has been employed in France for agglomeration of aerosols, ultrasonic drying, fog dispersal, and other interesting applications. A.

534.232

8477. EXPERIMENTAL INVESTIGATION OF CONICAL HORNS USED WITH UNDERWATER SOUND TRANSDUCERS.
W.R.Owens and C.M.McKinney.
J. Acoust. Soc. Amer., Vol. 29, No. 6, 744-8 (June, 1957).

An experimental study has been made of radiation patterns and axial gain in the Fraunhofer region for conical horns used in conjunction with underwater sound transducers. Results of the data are presented in a form that is useful in design of conical horns that have optimum dimensions. A.

534.232

8478. WEDGE-SHAPED ACOUSTIC HORNS FOR UNDERWATER SOUND APPLICATIONS. C.M.McKinney and W.R.Owens.
J. Acoust. Soc. Amer., Vol. 29, No. 8, 940-7 (Aug., 1957).

Gives the results of an experimental investigation of wedge-shaped acoustic horns used in conjunction with line hydrophones. An earlier study covered the frequency range from 50 kc/s to 150 kc/s. The measurements have now been extended to a lower value of 10 kc/s. Characteristic features of the horns are moderate directivity with minor lobes at least 40 dB below axial response. The horns, which are constructed from aluminum planes covered with

cellular rubber or Corprene, are simple devices and very easy to construct. Some related experiments concerning the basic operation of the horns are described. A.

534.26

8479. SCATTERING OF SOUND BY SOUND. P.J.Westervelt.
J. Acoust. Soc. Amer., Vol. 29, No. 8, 934-5 (Aug., 1957).

Earlier studies (Abstr. 4084/1957) of the mutual nonlinear interaction of two plane waves of sound with each other are extended to encompass arbitrary directions of travel of one wave with respect to the other; an exact solution to the first order scattering process is obtained. A.

534.3

8480. ACOUSTICAL DESIGN OF MODERN GERMAN ORGANS. W.Lottermoser.
J. Acoust. Soc. Amer., Vol. 29, No. 6, 682-9 (June, 1957).

Previous work on the acoustical qualities of several famous baroque organs, which is reviewed, reveals two maxima in the spectra of the "plenum" sounds, one at lower frequency formed by the fundamentals and lower harmonics, and one at a higher frequency formed by the partial tones of the mixture stops having several ranks of pipes. In Germany where many organs were destroyed in the last war, organists and parishes want to get new instruments of the same or a similar sound quality as the famous baroque organs. If approached in the usual way, this goal is reached only by extraordinary effort and dexterity. It is possible by acoustical planning, however, to attain with accuracy the desired spectra in a relatively short time. Two characteristic examples of such research are described here: the Praetorius organ at Freiburg and the Choir organ of St. Mary's Cathedral at Lübeck. In the first case, room acoustics were planned to get the desired sound–energy distribution for the organ. In the second case, proposals for the diameters and the installation of the pipes were made to adapt the organ to the room acoustics, in order to reproduce the characteristic baroque sound spectra in the nave of the church. A.

534.39 : 534.321.9

8481. ON THE ORIGIN OF THE BULGING AT A LIQUID SURFACE UNDER THE ACTION OF ULTRASOUND.
L.D.Rosenberg and L.O.Makarov.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 2, 275-6 (1957). In Russian.

An apparatus is described for producing bulging at the interface between oil and water. Observations with the apparatus suggest that the bulging is caused by the so-called "sonic wind" and not by radiation pressure (see also Abstr. 4010/1957). R.F.S.Hearmon

534.39 : 621.61

ACOUSTIC AIR PUMP. See Abstr. 8343

534.6

8482. MEASUREMENTS WITH ORDINARY SOUND AND ULTRASONICS CARRIED OUT IN THE PHYSICAL LABORATORY OF THE UNIVERSITY OF LOUVAIN. A.Van Itterbeek.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 584-7 (May, 1957).

Brief resumés of some of the acoustical research carried on at the University of Louvain during the year 1955-56. Descriptions of apparatus and methods, and some interpretation of the results are given. A.

534.614

8483. INTERFEROMETER FOR THE PRECISE MEASUREMENT OF THE VELOCITY OF ULTRASOUND IN LIQUIDS. A.Barone.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 717-28 (March, 1957).
In Italian.

534.62

8484. ULTRASONIC ABSORPTION BY STEADY THERMAL METHOD. S.Parthasarathy and S.S.Mathur.
Ann. Phys. (Leipzig), Vol. 19, No. 3-5, 242-6 (1956).

A new method of determining the ultrasonic absorption coefficients in liquids has been developed. A small cell containing a liquid is placed in the path of the ultrasonic beam produced in the liquid under investigation and is surrounded by a constant temperature bath. The steady difference in temperatures of the liquids in the cell and outside is measured for different positions of the cell along the path of the beam. The ultrasonic absorption coefficient α/ν^2 is determined from such measurements. A.

534.62

8485. DISPERSION EFFECTS IN ULTRASONIC WAVEGUIDES AND THEIR IMPORTANCE IN THE MEASUREMENT OF ATTENUATION. M.Redwood.
Proc. Phys. Soc. B, Vol. 70, Pt 8, 721-37 (Aug., 1957).

A study is made of the possible sources of error when the pulse technique is used to determine the absorption of compressional waves (of frequency 10-100 Mc/s) in low-loss solid materials, the specimens being cylindrical and acting as "waveguides". A theoretical analysis is made of a cylindrical guide with transmitting and receiving transducers of arbitrary size: for simplicity the medium is assumed initially to behave as a fluid, and equations describing the possible modes of propagation and their relative amplitudes for a "piston source" transmitter are developed. The case of transmitting and receiving transducers of diameter equal to that of the guide is treated in detail, and the theoretical voltage at the receiving transducer is plotted as a function of distance from the source; the effects of interference between the several modes of propagation are apparent. The analysis is extended to solid waveguides, where reflections at the walls of the guide produce a partial conversion to transverse waves. The practical effect of this on mode interference is discussed, and the final results of the analysis are compared with experiment. The estimated errors in the measurement of attenuation are tabulated for several frequencies and compared with the intrinsic absorption in fused silica and single crystal germanium. A.

534.62

8486. A NEW METHOD FOR THE DETERMINATION OF THE ACOUSTIC ABSORPTION COEFFICIENT IN LIQUIDS.
A.Carrelli and F.S.Gaeta.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 773-83 (April, 1957).

This is an optical method, making use of standing ultrasonic waves. Some results are given, in good agreement with the experimental results of other authors who worked with different methods at the same frequency and temperature. A noteworthy exception is the case of benzol, for which a value was obtained much lower (about a sixth) than the generally accepted experimental value. It is pointed out that benzol exhibited the strongest anomalies of the experimental absorption coefficient compared with the theoretical values. The authors' result is nearer the ideal value. A.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85

534.78 : 621.391

8487. THE INTELLIGIBILITY OF SYNTHETIC LANGUAGE. O.Warns.
Frequenz, Vol. 11, No. 6, 169-75 (June, 1957). In German.

A philosophical introduction analyses the differences in information content between spoken language and the same language in written or printed form, with particular reference to the actual language form, German or English, for example, and draws attention to the work done since Helmholtz, notably for the English language in "Visible Speech" (Potter, Kopp and Green). Investigations into the structure of written-down language by methods based on information theory suggest that it is possible to build up continuous speech from a number of arbitrarily interchangeable elements, on the assumption that language is a special system of signalling. On this assumption, it is possible to apply all the techniques of storage and coding known from data-processing machines. Experiments with listeners on the intelligibility of actual texts in which test elements giving vowel–consonant transitions are worked in lead to the supposition that for the identification of speech waves, subjective "signal-simulation" is decisive for articulation. A synthetic language (or speech), sufficient for the transmission of simple facts, can be built up by selection from 700-1100 elements, but the technical expenditure is very great. Bibliography of 8 references. W.J.Mitchell

534.781

8488. PERCEPTION OF VOWELS HEARD IN NOISES OF VARIOUS SPECTRA. J.M.Pickett.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 613-20 (May, 1957).

The perception of vowels heard in noises of various spectra is analysed by means of stimulus-response matrices. The stimulus vowels were spoken in PB-word lists and in syllable lists in which the vowels were equally probable. The matrices show shifts in vowel confusions depending on how different noise spectra mask the vowel formants. Vowel duration and intensity are measured and related to vowel perception. Vowel guessing is related to past training. A.

534.781

8489. EFFECTS OF VOCAL EFFORT UPON THE CONSONANT–VOWEL RATIO WITHIN THE SYLLABLE.
G.Fairbanks and M.S.Miron.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 621-6 (May, 1957).

Subjects spoke /s/-vowel-/s/ monosyllables at two syllabic levels which required a large contrast in effort without extreme

departure from average conversational effort. At the higher level the median within-syllable consonant–vowel ratio was approximately −14 dB; at the lower level (vowel 18 dB down) it was approximately −7 dB. The ratio also varied with position of the consonant within the syllable, with vowel and with sex of speaker; effort, vowel, and sex interacted. The variations were systematic and large enough to have implications for intelligibility. A.

534.781

8490. WORD INTELLIGIBILITY AS A FUNCTION OF TIME COMPRESSION. G.Fairbanks and F.Kodman, Jr.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 636-41 (May, 1957).

An experiment is described in which words were automatically compressed in duration and presented to observers for identification. The effects of time compression and of time sampling are assessed, and compared with those of periodic interruption. The results of an analogous nonauditory study of the effects of phonemic sampling are presented. A.

534.781

8491. CASE OF THE UNKNOWN TALKER. C.D.Creelman.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 655 (May, 1957).

An articulation test in which words were spoken by different talkers was carried out to help compare human performance with that of automatic digit recognizing machines. Phonetically balanced words spoken by eight females and eight males were recorded on tapes which were spliced and arranged to include 25 words spoken by 1, 2, 4, 8 and 16 different talkers. Speech to noise ratios of +6,0,−6 dB were used with five listeners. The articulation score decreased slightly, by about 7%, for more than two talkers. D.J.Hall

534.781

8492. REMARKS ON RARE PB WORDS. J.P.Egan.
J. Acoust. Soc. Amer., Vol. 29, No. 6, 751 (June, 1957).

The Harvard PB-word lists used in articulation tests have found application in the comparison of various communication devices, and in the clinical diagnosis of types of deafness. Research on the correlation between the audibility of words and their frequency of usage has established that rare words tend to have low articulation scores. It has not been reported what happens to the correlation coefficients when the listeners have practised listening to the word lists. Practice should be given with the lists under each experimental condition, and several lists should be used. D.J.Hall

534.79

8493. CRITICAL BAND WIDTH IN LOUDNESS SUMMATION. E.Zwicker, G.Flottorp and S.S.Stevens.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 548-57 (May, 1957).

The concept of the critical band, or Frequenzgruppe, is shown to apply to loudness summation. When the spacing between a group of pure tones is increased, the loudness remains constant until a critical point is reached, after which the loudness increases. The same effect occurs when the width of a band of noise of constant SPL is made larger. The critical band width at which loudness summation begins to depend on the spread of energy is approximately the same as the critical band width determined previously by methods involving thresholds, masking, and phase. The critical band as measured directly by these three methods (plus the method of loudness summation) is about two-and-a-half times as wide as the critical band derived from the assumptions made by Fletcher, but its dependence on frequency is approximately the same. The relation of the critical band to other functions is noted. A.

534.79

8494. CONCERNING THE FORM OF THE LOUDNESS FUNCTION. S.S.Stevens.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 603-6 (May, 1957).

In order to examine certain possible irregularities in the loudness function, the method of adjustment was used to halve and double the loudness of a 1000 c/s tone at the levels, 30, 60, 90, and 120 dB relative to 0.0002 μbar. The results tend partially to confirm some of the irregularities found by Robinson. The results also indicate that a reasonable approximation to the loudness function is the rule that a change of 10 dB corresponds to a loudness ratio of 2 : 1. This means that loudness grows approximately as a power function of intensity. It is noted that the power function also describes the relation between psychological magnitude and stimulus magnitude on a dozen other perceptual continua. A.

534.846 : 534.3

8495. ACOUSTICAL AND ORGAN DESIGN FOR CHURCH AUDITORIUMS. A.R.Rienstra.
J. Acoust. Soc. Amer., Vol. 29, No. 7, 783-8 (July, 1957).

The acoustical design of a church auditorium is of equal importance to that of the architectural design. It is essential, then, that the acoustical design follow the principles of projecting sound from the source to the listeners with maximum fidelity both for the listeners and for the performers. Church acoustics has varied from the dead, low reverberent type at one extreme to the excessively reverberant type at the other extreme. In between these extremes is a range of good listening conditions for music and speech, for all types of liturgy. Longer reverberant times than usual are recommended for small and medium size auditoriums. The enhancement effect of reverberation on musical tones is shown to be related to the optimum reverberation characteristic. A new design of church auditorium is submitted which is interesting in its novelty, and still is practical from a modern architectural point of view. Organ design has passed through extremes such as the pure romantic and the baroque. Either in its extreme is undesirable for general church use. Space requirements for organs and some principles of organ design including the design of mixtures to meet any reasonable acoustic condition are given. This paper is given to stress the musical point of view of church design to the acoustician and architect so that extremes in acoustics will be avoided in the future. A.

534.846

8496. ORTHOPHONIC SURFACES IN AUDITORIUM DESIGN. C.Codegone.
J. Acoust. Soc. Amer., Vol. 29, No. 8, 885-8 (Aug., 1957).

A study is made, in a particular case, of the shape to be given to the ceiling of a large auditorium such that the sum of the direct intensity and the intensity reflected by the ceiling is constant. It is assumed that the source is an arc of a circle in a horizontal plane with a uniform intensity distribution. The shape of the reflecting ceiling, which in this case is a surface of revolution, is given by a graphical construction founded upon mathematical conditions. The results may also be applied to both optical and thermal fields. A.

534.862.3 : 621.395.625.3

8497. ACOUSTICAL TIME REGULATOR. A.M.Springer.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 341-3 (March, 1957).

Describes a device for altering the speed of reproduction of tape recordings, by mechanical means, without altering the frequency and therefore the pitch. The playback time can be changed within a range of 50-200% of the recording time. Although there are no technical limits to the range of time-change, a certain loss of quality begins to become apparent if the time-change is increased beyond ±30%. The possibilities of application are also discussed. A.

OPTICS. RADIATION. SPECTRA 535

535.14

8498. THEORY OF THE RADIATION OF PHOTONS OF SMALL ARBITRARY MASS. E.C.G.Stueckelberg.
Helv. phys. Acta, Vol. 30, No. 2-3, 209-15 (1957). In French.

If the photon has a mass $\hbar\mu \neq 0$, a canonical transformation yields a Hamiltonian containing the energies: (1) of the charged field (including the Yukawa potential energy); (2) of the transversal and longitudinal photons, and (3) an interaction term. The interaction term between charge and longitudinal photons is smaller than the transversal term by a factor μ/ω, if $\hbar\omega$ is the photon energy Thus the limit $\mu \to 0$, which replaces the Yukawa potential by the Coulomb potential, is possible. The longitudinal photons, presenting no interaction, can pass freely through the walls of a cavity and Planck's radiation law holds. The necessary and sufficient condition for this result is the continuity equation for electric charge. A.

535.14

8499. ON THE CLASSICAL FLUCTUATION OF A BEAM OF LIGHT. L.Jánossy.
Nuovo Cimento, Vol. 6, No. 1, 111-24 (July, 1957).

The fluctuation of intensity of a light beam emitted by a macroscopically constant source is evaluated. The generating function of the distribution is determined exactly; it is found that the moments of the distribution are in good approximation those of a Gaussian distribution. Recent experiments on photon coincidences are discussed. A.

535.241.39 : 551.521.326

8500. STANDARD OF LOW LUMINANCE FOR STUDYING THE LIGHT OF THE NIGHT SKY. D.Barbier and P.Lévêque.
Rev. Opt., Vol. 36, No. 3, 132-4 (March, 1957). In French.

A fluorescent source consisting of willemite excited by Sr^{90}. A.

535.247.4

8501. AUTOMATIC COMPENSATION OF LAMP INTENSITY FLUCTUATIONS APPLICABLE TO RECORDING PHOTOMETERS. T.J.Buma.
Physica, Vol. 22, No. 12, 1215-18 (Dec., 1956).

A simple amplifier is described, which is used to amplify the signal of a photomultiplier tube in optical experiments and at the same time compensates for the brightness fluctuations of the light source. The automatic compensation is obtained by controlling the gain of the amplifier by means of a variable-mu pentode. The output-signal proved to be independent of lamp intensity variations up to 50%. A.

535.317

8502. NEW STIGMATIC SYSTEM OF THE CONCENTRIC TYPE. G.Toraldo di Francia.
J. Opt. Soc. Amer., Vol. 47, No. 6, 566 (June, 1957).

An optical system consisting of a sphere of variable refractive index is described. The index is a positive finite function of the distance r from the centre, and the values are more favourable than in the case of a Luneberg lens. Any point on the surface of the sphere is imagined at infinity, without aberration and at a relative aperture of f/0.5. The equation for determination of the refractive index is quoted and some ray traces illustrated. R.W.Fish

535.317.2

8503. METHOD OF MEASUREMENT OF RESPONSE FUNCTION BY MEANS OF RANDOM CHART. H.Kubota and H.Ohzu.
J. Opt. Soc. Amer., Vol. 47, No. 7, 666-7 (July, 1957).

It is proposed that the response function of an image-forming system be found from the cross-correlation function between a random test chart and its image and the autocorrelation function of the chart. Some experimental results are reported using this method which agree well with the theoretical response of the optical system tested. E.A.Mussett

535.317.25

8504. RESOLVING POWER. J.H.Jacobs.
J. Opt. Soc. Amer., Vol. 47, No. 6, 564 (June, 1957).

A comment on Abstr. 1165 (1957) which suggested that objects smaller than the wavelength of the radiation could be resolved. Resolving power is the ability to distinguish small angular differences in the direction of arrival of the radiation. A strict analogy in sound to the usual optical case is proposed. R.W.Fish

535.317.25

8505. ON THE THEORETICAL LIMIT OF RESOLUTION. M.V.R.K.Murty.
J. Opt. Soc. Amer., Vol. 47, No. 7, 667-8 (July, 1957).

The size and shape of the diffraction pattern for an off-axis star image formed by a perfect lens is found theoretically as a function of the semi-field angle θ. Hence curves are plotted showing how the resolving power falls off as θ increases. E.A.Mussett

535.33.07

8506. DESIGN OF A 21 FT SPECTROGRAPH USING A PLANE GRATING. I. THE PLANE GRATING IN CONVERGENT LIGHT. E.W.T.Richards, A.R.Thomas and W.Weinstein.
Atomic Energy Res. Establ. (Harwell) Rep. C/R2152, 6 pp. (1957).

A spectrograph for u.v. and visible light was constructed using a 30 000 lines per inch, 6 by 5 in., plane replica grating in convergent light, after Gillieson (Abstr. 201/1950). A large amount of coma was found and this is confirmed in a theoretical investigation, showing that the plane grating cannot be used in convergent light without great loss in line sharpness. There is a brief discussion of the merits of plane and concave gratings in spectrographs. W.Weinstein

535.331

8507. HYPERFINE STRUCTURE IN THE SPECTRUM OF INDIUM II. D.A.Jackson.
J. Phys. Radium, Vol. 18, No. 3, 145-56 (March); Erratum, No. 5, 364 (May, 1957). In French.

Measurements of the hyperfine structure of lines in the spectrum of In II emitted by a hot hollow cathode discharge made by Paschen and Campbell with a concave grating, showed interval ratios with large divergences from the interval rule; in the work now described the hyperfine structure of the multiplet $5\ ^3D_{3,2,1} - 4\ ^3F_{4,3,2}$ (4638 to 4685 Å) of the same spectrum has been re-determined with a water cooled hollow cathode as light source and a Fabry–Perot etalon, with multilayer dielectric reflecting surfaces as the instrument of high resolving power. Due to the smaller width of the lines emitted by the cooled hollow cathode and the greater effective resolving power of the etalon, more complete resolution of the structure was effected so that a substantially more accurate evaluation of the interval ratios in the terms $5\ ^3D_{3,2,1}$ and $4\ ^3F_{4,3,2}$ and $4\ ^1F_3$ was possible. Although the new measurements make necessary some changes in the correlation of the transitions and the observed hyperfine structure components, the new analysis is in the main in agreement with the original analysis of Paschen and Campbell, and the large departures from the interval rule are confirmed; the cause of these divergences is discussed. The indium used in the hollow cathode was natural indium containing 96% In^{115} and 4% In^{113}; no indication of resolved components due to the rarer isotope was found. A.

535.231

8508. HYPERFINE STRUCTURE IN THE ARC SPECTRUM OF MERCURY AND QUADRUPOLE MOMENT OF Hg^{201}. J.Blaise and H.Chantrel.
J. Phys. Radium, Vol. 18, No. 3, 193-200 (March, 1957). In French.

The hyperfine structure of the lines corresponding to the transitions 6s6p–6s7s and 6s6p–6s7d of Hg I have been measured accurately. The 6s7d $^1D_2$ and 6s7d $^3D_2$ terms show anomalies due to the fact that the hyperfine structure is of the same order of magnitude as the multiplet structure of the 6s7d configuration. The ratio of the magnetic moments is: $\mu^{201}/\mu^{199} = -1.110 \pm 0.001$. The values of the quadrupole moment of Hg^{201} calculated from the 6s6p $^3P_2^0$, $^3P_1^0$ and $^1P_1^0$ terms are 0.48, 0.55 and 0.27 x 10^{-24} cm^2, respectively. A possible explanation of these discrepancies is given. The best value is: $Q = (0.50 \pm 0.05) \times 10^{-24}$ cm^2. A.

535.331

8509. ISOTOPE SHIFT IN THE SPECTRUM OF INDIUM I. D.A.Jackson.
J. Phys. Radium, Vol. 18, No. 7, 459-67 (July, 1957). In French.

The isotope shift in five lines of the arc spectrum of indium has been determined from a comparison by means of a Fabry–Perot interferometer of the wavelengths of these lines emitted by a hollow cathode tube containing natural indium and a similar tube containing indium enriched in In^{113}. The shift has also been measured in one of these lines (4101 A) by direct measurement of the separation of pairs of components due to the two isotopes, the lines having been resolved in an atomic beam produced with indium enriched in In^{131}, observed in absorption with a double Fabry–Perot etalon. A.

535.331

8510. THE INFLUENCE OF HELIUM ON THE 2536.52 A LINE OF MERCURY. A.Michels and H.de Kluiver.
Physica, Vol. 22, No. 10, 919-31 (Oct., 1956).

The 2535.52 A ($^1S_0 - ^3P_1$) line of mercury is observed in absorption in the presence of helium compressed up to 1500 atm. Line shape, oscillator strength, shift and half-width of the line are measured as a function of the density of helium. The line shifts towards the violet and broadens asymmetrically with increasing helium density, developing a pronounced shoulder about 14 Å from the main peak, on the violet side. The observed ratio of half-width to shift (5.1 at low densities) disagrees with the prediction based on Lindholm's theory of pressure broadening with Van der Waals interactions. With repulsive (R^{-12}) interactions only, the Lindholm theories gives rough agreement. On the other hand, the statistical theory of Margenau can qualitatively explain the occurrence of a shoulder. The oscillator strength decreases rapidly with increasing density. A.

535.331

8511. HYPERFINE STRUCTURE COUPLING CONSTANT OF THE 6s6p $^3P_1$ LEVEL OF ^{199}Hg BY DOUBLE RESONANCE. G.S.Bogle, J.N.Dodd and W.L.McLean.
Proc. Phys. Soc. B, Vol. 70, Pt 8, 796-800 (Aug., 1957).

A double resonance experiment on natural mercury is described. The value of the hyperfine structure coupling constant of the 6s6p$^3P_1$ level of Hg^{199} obtained is 0.497 ± 0.014 cm^{-1}. A.

535.333

8512. STUDY OF THE $A^1\Pi \rightarrow X^1\Sigma^+$ BANDS OF $B^{11}F$ WITH A VACUUM ECHELLE SPECTROGRAPH. R.Onaka.
J. chem. Phys., Vol. 27, No. 2, 374-7 (Aug., 1957).

The $A^1\Pi \rightarrow X^1\Sigma^+$ bands of $B^{11}F$ which had been found by Chrétien and Miescher (Abstr. 5332/1949) were now studied with the aid of

a higher dispersion spectrograph and more accurate molecular constants were obtained, i.e., $A\,^1\Pi$: $T_e = 51157.4_8\ cm^{-1}$, $\omega_e = 1264._{96}\ cm^{-1}$, $\omega_e x_e = 12.5_3\ cm^{-1}$, $\omega_e y_e = -0.24_2\ cm^{-1}$, $B_e = (c)1.420_5\ cm^{-1}$, (d) $1.420_7\ cm^{-1}$, $\alpha_e = 0.016_5\ cm^{-1}$, $\gamma_e = -0.0005_7\ cm^{-1}$, $D = 7 \times 10^{-6}\ cm^{-1}$, $r_e = 1.304_7$A; $X\,^1\Sigma^+$: $\omega_e = 1402.1_3\ cm^{-1}$, $\omega_e x_e = 11.8_4\ cm^{-1}$, $\omega_e y_e = +0.05_6\ cm^{-1}$, $B_e = 1.510_7\ cm^{-1}$, $\alpha_e = 0.016_5\ cm^{-1}$, $\gamma_e = -0.0001_5\ cm^{-1}$, $D = 7 \times 10^{-6}\ cm^{-1}$, $r_e = 1.265_2$A. Λ-type doubling was observed in the $A\,^1\Pi$ state, and a brief discussion of the doubling is given. A.

535.333

8513. INFRARED EMISSION SPECTRUM OF CALCITE.
J.A.A.Ketelaar and C.Haas.
Physica, Vol. 22, No. 12, 1283-5 (Dec., 1956).

The polarized infrared emission and reflection spectra of calcite were measured at 300°C; the results are in quantitative agreement with Kirchhoff's law. A.

535.338.334

8514. WIDTH AND SHIFT OF SPECTRAL LINES DUE TO DISSIPATIVE INTERACTION. R.Brout.
Phys. Rev., Vol. 107, No. 3, 664-8 (Aug. 1, 1957).

The theory of line width due to dissipative interactions, such as collisions, is examined for the case of weakly coupled systems (weak collisions). It is shown that the apparent paradox that the width of the energy of the total system is of the order of Avogadro's number is resolved by a substraction procedure. The width of a spectral line is the difference in widths of the two macroscopic states before and after the transition. This should be contrasted to the case of natural line width where the width of the line is the sum of the widths of the two states involved. The physical reason for the difference in sign is discussed. A.

535.342

8515. THE EFFECTIVE FIELD AND THE FREQUENCY OF OVERTONES AND COMBINATION BANDS IN THE VIBRATION SPECTRA OF CRYSTALS. C.Haas and J.A.A.Ketelaar.
Physica, Vol. 22, No. 12, 1286-90 (Dec., 1956).

It is shown that the effective field may cause a shift of the fundamental absorption bands in a crystal, while the frequency of overtones and combination bands remains unchanged. This effect, which complicates the interpretation of overtones and combination bands, is illustrated by the absorption spectra of sodium nitrate and calcite. A.

535.343 : 548.7

8516. THE LINE SPECTRUM OF THE BASIC ABSORPTION EDGE AND THE STRUCTURE OF CADMIUM SULPHIDE CRYSTALS.
E.F.Gross, B.S.Razbirin and M.A.Yakobson.
Zh. tekh. Fiz., Vol. 27, No. 1, 207-9 (1957). In Russian.

In continuation of the research work described in previous papers (Zh. tekh. Fiz., Vol. 25, 364, 1955; Dokl. Akad. Nauk SSSR, Vol. 102, 485, 1955), the authors investigated the absorption of light in CdS crystals at temperatures of liquid He, and obtained the following results: (1) the narrow bands in the strong-absorption region on the short-wave side of the line absorption spectrum reveal fine structure; (2) both the fine lines and the bands show a varying degree of polarization; (3) the narrow absorption lines at the long-wave side of the basic absorption edge are very sensitive to conditions at which the CdS crystals are formed and grown, and (4) the line spectrum varies not only from one crystal to another, but also from one region of a crystal to another. F.Lachman

535.343 : 535.37

8517. UNIVERSAL RELATIONSHIP BETWEEN THE ABSORPTION AND LUMINESCENCE SPECTRA OF COMPLEX MOLECULES.
B.I.Stepanov.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 5, 839-41 (1957). In Russian.

Three equations are derived, enabling the form of the luminescence spectrum to be calculated from that of the long-wave absorption band, or vice versa. The equations are not fulfilled (1) when the time of excitation is too short for the thermal distribution among the vibration sub-levels to be established, or (2) when the non-excitation absorption is strong. The equations are strictly applicable only to condensed phases. The experimental data so far available are insufficient for checking the correctness of the relationship derived. F.Lachman

535.343

8518. SPECTRA OF THE ALKALI HALIDES. II. THE INFRARED SPECTRA OF THE SODIUM AND POTASSIUM HALIDES, RbCl, AND CsCl. S.A.Rice and W.Klemperer.
J. chem. Phys., Vol. 27, No. 2, 573-9 (Aug., 1957).

For Pt I see Abstr. 4151 (1957). The infrared spectra of NaCl, NaBr, NaI, KCl, KBr, RbCl, CsCl in the gas phase have been measured in the region of the fundamental vibration frequency. The vibrational frequencies calculated from the observed spectra are: NaCl $\omega_e = 366\ cm^{-1}$, NaBr $\omega_e = 302\ cm^{-1}$, NaI $\omega_e = 258\ cm^{-1}$, KCl $\omega_e = 281\ cm^{-1}$, KBr $\omega_e = 213\ cm^{-1}$, RbCl $\omega_e = 228\ cm^{-1}$, CsCl $\omega_e = 209\ cm^{-1}$. This data, together with previous data on the lithium halides, permits extrapolations to be made to determine the vibrational frequencies of the following halides: KI $\omega_e = 173\ cm^{-1}$, RbBr $\omega_e = 166\ cm^{-1}$, RbI $\omega_e = 128\ cm^{-1}$, CsBr $\omega_e = 139\ cm^{-1}$, CsI $\omega_e = 101\ cm^{-1}$. The classical ionic model for the gaseous alkali halides is found to be in quantitative agreement with experiment. Some aspects of the problem of dimers in the gas phase are discussed. A.

535.343

8519. l-TYPE DOUBLING IN THREE $\pi-\pi$ BANDS OF HCN.
D.H.Rank, J.N.Shearer, A.H.Guenther and T.A.Wiggins.
J. chem. Phys., Vol. 27, No. 2, 532-4 (Aug., 1957).

The l-type doubling constants have been determined for the 01^12-01^10, 01^13-01^10 and 03^11-01^10 bands of HCN. The results, in units of $10^{-3}\ cm^{-1}$, are:

	01^12	01^13	03^11
q'	7.71	7.54	15.4
q''	7.51	7.26	7.21

The accuracy of the constants is ±5% for the 01^13 and 03^11 bands, and ±1% for the 01^12 band. The q'−q'' values obtained for the 01^13 and 01^12 bands agree within experimental error with the prediction of an empirical equation which relates q to the vibrational quantum numbers. A.

535.343

8520. INFRARED ABSORPTION SPECTRA OF NITRIC ACID AND ITS SOLUTIONS. R.A.Marcus and J.M.Fresco.
J. chem. Phys., Vol. 27, No. 2, 564-8 (Aug., 1957).

Infrared spectra of reactive liquids such as anhydrous nitric and sulphuric acids were determined using silver chloride windows and, in some cases, Telfon spacers. The absorption frequencies of nitric acid agree well with those found from Raman spectra. A nitronium ion frequency was observed at 2360 cm^{-1}. The intensity of this band is enhanced by the addition of nitronium fluoborate, sulphuric acid, phosphorous pentoxide, or small amounts of acetic anhydride. It is reduced by addition of sodium nitrate, potassium dihydrogen phosphate, water or larger amounts of acetic anhydride. Its behaviour in these media provides information about pertinent equilibria. A nitronium ion combination band was observed near 3745 cm^{-1} when the concentration of this ion was particularly large. Bands arising from unionized nitric acid are completely absent when a small amount of nitric acid is added to 100% H_2SO_4. Various bands found in aqueous nitric acid solutions are attributed to hydrogen-bonded structures, both because of their behaviour in different media and by analogy with effects observed in Raman studies. A.

535.343 : 548.7

8521. THE EFFECTS OF RADIATION ON THE NEAR INFRARED ABSORPTION SPECTRUM OF α-QUARTZ.
E.W.J.Mitchell and J.D.Rigden.
Phil. Mag. (Eighth Ser.), Vol. 2, 941-56 (Aug., 1957).

The variation of the absorption strength and spectrum in the region of 3 μ has been determined for different specimens of crystalline quartz and for X-ray, electron and pile irradiated crystals. It is shown that the 3 μ group of bands is associated with imperfections rather than harmonics or combinations of lattice vibration frequencies, and that the imperfections are not Frenkel or Schottky defects. Two of the bands, 2.88 and 2.95 μ, are anisotropic, having anisotropic absorption ratios $(E_{\parallel} c/E_{\perp} c) \leq 0.130$ and ≤ 0.145 respectively. A band is induced by pile irradiation at 2.79 μ but tends to saturate at a low dose ($< 10^{19}\ n^0\ cm^{-2}$). The band is not produced by ionizing radiation. It is suggested that the 2.79 μ band may be due to O—H bond formation by association of hydrogen impurity with the products of atomic damage. This band is also anisotropic with a ratio of 0.71. Possible defect axis directions which could give the observed anisotropic ratios are discussed. A.

535.343

8522. ANALYSIS OF THE INFRARED ABSORPTION SPECTRA OF DIFFERENT NITRATE CRYSTALS IN TERMS OF THE SINGLE-CELL MODEL. H.G.Häfele.
Z. Phys., Vol. 148, No. 2, 262-80 (1957). In German.

Absorption curves are determined at λ = 2 − 20 μ, at room temperature and at T = −165°C, with polarized radiation for single crystals of $Pr_2Zn_3(NO_3)_{12}.24H_2O$, $Ce(NO_3)_2.6H_2O$, $ZnSO_4.7H_2O$,

$NaNO_3$ and $Mg(NO_3)_2.6H_2O$. The various observed frequencies are assigned in terms of harmonics and combinations of the fundamental vibration frequencies of H_2O and the NO_3 ion. Consideration of the unit cell only, in spite of its simplicity, gives correctly many properties of the crystal vibrations. G.F.Lothian

535.343 : 535.375.5

8523. VIBRATIONAL SPECTRUM OF 3,3,3-TRICHLORO-PROPENE-1. E.R.Shull.
J. chem. Phys., Vol. 27, No. 2, 399-401 (Aug., 1957).

The Raman spectrum and qualitative depolarizations of the Raman bands of the liquid phase of 3,3,3-trichloropropene-1 and the infrared spectra of the liquid and gas phases have been obtained. A very low Raman frequency, $\Delta\nu = 99$ cm^{-1}, attributable to the torsional vibration of the CCl_3 group about the C–C bond was observed and a number of the Raman bands were found to be highly depolarized. The observed frequencies consequently have been assigned on the basis of a planar structure (symmetry group C_s). A.

535.343 : 535.375.5

8524. VIBRATIONAL SPECTRA OF SYM-TRIOXANE.
A.T.Stair, Jr and J.R.Nielsen.
J. chem. Phys., Vol. 27, No. 2, 402-7 (Aug., 1957).

The Raman spectra of liquid sym-trioxane contained in a sealed, electrically heated Raman tube, and of a crystalline aggregate and a single crystal of the compound, have been photographed with a 3-prism glass spectrograph of reciprocal linear dispersion 15 A/mm at 4358 A. The infrared spectrum of trioxane vapour has been reinvestigated with the aid of a 1 m absorption cell and a double pass spectrometer equipped with CsBr, NaCl, and LiF prisms. The 17 active fundamentals have been assigned as follows: Species a_1: 2853, 2792, 1496, 975, 943, 752, and 524 cm^{-1}; species e: 3031, 2753, 1477, 1408, 1305, 1175, 1072, ~ 1050, ~ 460, and 307 cm^{-1}. The spectra have been interpreted in detail, and their dependence upon the state of aggregation has been discussed. A.

535.343

8525. INFRARED SPECTRUM OF TRIFLUOROACETIC ACID VAPOR. R.E.Kagarise.
J. chem. Phys., Vol. 27, No. 2, 519-22 (Aug., 1957).

The infrared absorption in the region between 2 and 24μ has been studied as a function of temperature. At room temperature both monomer and dimer molecules are present, while at 100°C the vapour is predominately monomeric. On the basis of the resulting intensity changes it has been possible to conclusively identify the bands due to the two species. A partial assignment of the fundamental modes of vibration has been made using these data and the previously published spectrum of the deuterated acid. The heat of dissociation (ΔH) for the dimer–monomer reaction has been determined from the temperature dependence of the OH stretching bands and found to be 13.7 ± 0.4 kcal/mole. A.

535.343 : 535.375.5

8526. RAMAN AND INFRARED SPECTRA OF CCl_3CN.
W.F.Edgell and C.J.Ultee.
J. chem. Phys., Vol. 27, No. 2, 543-5 (Aug., 1957).

The spectra have been obtained and the observed frequencies were assigned to the fundamental modes of vibration and their combinations. A normal coordinate treatment of the vibrations has been carried out, using a simple valency force field, supplemented with additional terms representing the interactions between the various nonbonded atoms in the molecule. A.

535.343

8527. TEMPERATURE VARIATION OF MICROWAVE ABSORPTION COEFFICIENT IN ETHYL CHLORIDE.
Krishnaji and G.P.Srivastava.
Proc. Phys. Soc. B, Vol. 70, Pt 6, 621-2 (June, 1957).

The variation of the microwave loss of C_2H_5Cl at 8780 Mc/s is expressed as α = (const.) T^{-x}, with x varying from 4.9 at 25 cm pressure to 3.2 at 45 cm with a temperature range 262 to 354°K. This is interpreted as support for the bandwidth varying as T^{-1}. D.H.Whiffen

535.371

8528. TWO ARSENATE PHOSPHORS AND THE SIGNIFICANCE OF THEIR EMISSION. G.R.Fonda.
J. Electrochem. Soc., Vol. 103, No. 7, 400-3 (July, 1956).

Four phosphors of weak to moderate luminescence were prepared: two from zinc arsenate activated separately with lead and manganese, and two from calcium fluoroarsenate activated with antimony alone and with antimony and manganese together. Their manganese emission band was shifted to longer wavelengths than is characteristic of their phosphate homologues: from 6380 A to 6550 A in the case of the zinc compounds, and from 5680 A to 6200 A for the fluoroapatites. The effect was ascribed to depression of excitation levels of activator ions under increased field strength of oxygen ions in their environment. A.

535.371

8529. PROPOSED MODELS FOR TRAPS IN ZnS PHOSPHORS; THERMAL AND OPTICAL ACTIVATION. D.Curie.
J. Phys. Radium, Vol. 18, No. 4, 214-22 (April, 1957). In French.

The following models are described and their thermal (E) and optical ($h\nu$) activation energies have been derived: (a) "Hydrogen-like atom model" for shallow traps (E = 0.3 eV). The trapped electron is assumed to remain in the field of a substitutional charge $+\epsilon$. (b) "Hydrogen-like molecule-ion model" for the deep traps (E = 0.5-0.8 eV). When two substitutional charges $+\epsilon$ are associated in pairs of nearest neighbours, second neighbours etc..., traps are obtained, the theoretical depths of which are the same as the experimental depths observed on both hexagonal and cubic ZnS(Cu). A.

535.376 : 537.311.33

8530. EXHAUSTION BARRIERS IN ZINC SULPHIDE.
G.F.Alfrey and K.N.R.Taylor.
Helv. phys. Acta, Vol. 30, No. 2-3, 206-8 (1957).

The nature of the exhaustion barrier at a metallic contact to a zinc sulphide crystal is considered in the light of the evidence of electroluminescence and of the effect of electric fields on the scintillations produced by alpha-particles. The evidence suggests that the donar states whose depletion gives rise to the barrier are concentrated at a single energy level, rather than distributed through the forbidden band. A.

535.376

8531. FLUORESCENT RESPONSE OF CsI(Tl) TO ENERGETIC NITROGEN IONS. M.L.Halbert.
Phys. Rev., Vol. 107, No. 3, 647-50 (Aug. 1, 1957).

The light output of a CsI(Tl) crystal was measured as a function of energy for nitrogen ions from 2.9 to 23.8 MeV, for α-particles up to 5.30 MeV, and for γ-rays of 73, 279.2, and 411.8 keV. The particle energy was varied with absorbing foils. The response to nitrogen ions was proportional to energy up to about 16 MeV. Above this energy a slight curvature of the response curve away from the energy axis was observed. The response to α-particles was linear above about 3.5 MeV and extrapolated to ~1 MeV on the energy scale. The light output from the γ-rays was proportional to their energy and parallel to the linear portion of the α-particle response. The specific fluorescence dL/dx appears to be an increasing function of the specific energy loss dE/dx. A.

535.377

8532. THE THERMOLUMINESCENCE OF CaF_2:Mn.
R.J.Ginther and R.D.Kirk.
J. Electrochem. Soc., Vol. 104, No. 6, 365-9 (June, 1957).

The thermoluminescence of manganese-activated calcium fluoride has been found to be dependent on both its manganese content and the presence of other foreign ions. Sodium and oxygen promote high temperature glow peaks, whereas the addition of trivalent cations causes the thermoluminescence of oxygen-containing material to occur at lower temperatures. Thermoluminescence may be excited by X-rays, by mechanical handling, or by irradiation with blue light. Glow peak positions are independent of the method of excitation. A.

535.39 : 539.234

8533. REFLECTIVITY AT NORMAL INCIDENCE IN THE VISIBLE AND U.V. REGIONS OF VACUUM EVAPORATED FILMS OF SELENIUM AND TELLURIUM. S.Kandare.
C.R. Acad. Sci. (Paris), Vol. 244, No. 21, 2594-7 (May 20, 1957). In French.

Curves are given for the wavelength range 1100-5800A; opaque films were used. Increased u.v. reflectivity was observed on evaporating from a Ta boat. W.Weinstein

535.39

8534. ABSORPTION AND DISPERSION OF INDIUM ANTIMONIDE.
T.S.Moss, S.D.Smith and T.D.F.Hawkins.
Proc. Phys. Soc. B, Vol. 70, Pt 8, 776-84 (Aug., 1957).

Transmission measurements have been used to determine absorption coefficients over the wavelength range 1.5-7.5μ, and interferometric determinations made of the refractive index from 7-20μ. It is shown that the following four factors contribute significantly to the dispersion: (i) short-wave absorption band centred in the visible region, (ii) tail absorption band, (iii) free carrier absorption, (iv) Restrahlen band. The "characteristic" value of refractive

index occurs at approximately 10μ, where it is 3.96. A more accurate calculation is made of the radiation lifetime. Using these data, $\tau_R = 0.79\mu$sec. A.

535.39 : 539.234

8535. THE MEASUREMENT OF THE OPTICAL PROPERTIES OF ZINC SULPHIDE. C.K.Coogan.
Proc. Phys. Soc. B, Vol. 70, Pt 9, 845-61 (Sept., 1957).

The knowledge, to date, of optical absorption in ZnS is surveyed and discussed. The method used for determining the optical absorption and refractive index of a solid over a range of wavelengths is discussed and equations deduced for the transmittance and reflectance of a thin absorbing film on a thick substrate. The practical determination of the refractive index and extinction coefficient from the measured values of transmittance and reflectance is discussed in some detail. A description is given of the experimental procedure and precautions used in determining the optical constants of evaporated layers of ZnS. The results are discussed in relation to previous work. The effects of change of temperature at which the measurements are made, and of exposure of the films to air are noted and discussed. A.

535.393 : 539.23

8536. ON THE REFLECTION COEFFICIENTS OF THIN, LACUNAL FILMS. P.Dumontet, M.Perrot and J.Tortosa.
C.R. Acad. Sci. (Paris), Vol. 244, No. 20, 2488-91 (May 13, 1957). In French.

It is pointed out that the observed variation, with thickness, of the complex reflection coefficient for the substrate side of a silver film deposited on a transparent support differs markedly for thicknesses less than 100 A from that expected theoretically. A transitional layer at the substrate surface is suggested as the cause of the anomaly. E.A.Mussett

535.393

8537. THE TEMPERATURE COEFFICIENT OF REFLECTIVITY OF NICKEL. L.Ward.
Proc. Phys. Soc. B, Vol. 70, Pt 9, 862-6 (Sept., 1957).

The variation with temperature of the reflecting power of nickel has been measured by a null method at five wavelengths in the near infrared region of the spectrum. The results are in satisfactory agreement with those calculated from previous work on emissivity. There was no conclusive evidence for a significant change in reflectivity at the Curie point. A.

535.417 : 531.715.1

8538. INTERFERENCE METHODS FOR THE MEASUREMENT OF LONG END-STANDARDS. C.Hoffrogge.
Z. InstrumKde, Vol. 65, No. 7, 123-5 (July, 1957). In German.

The methods are for end standards which are too long to measure directly by optical interference. The overall length is therefore virtually subdivided by the images of reference mirrors, interference fringes being obtained between these mirrors and the ends of the standard. The fractional part of the order of interference of the overall length is equal to the sum of the fractional parts of the orders of the subdivisions. Kösters double prisms are used as beam dividers. A.H.Cook

535.417 : 681.4

8539. A TWYMAN INTERFEROMETER FOR THE TESTING OF OBJECTIVES. J.Hartmann and J.Hertel.
Z. InstrumKde, Vol. 65, No. 7, 130-2 (July, 1957). In German.

Details are given of the mechanical design of a Twyman interferometer suitable for testing small objectives. Special attention is devoted to the compensator plate. S.Tolansky

535.42 : 535.8

8540. OPTICAL SYSTEMS WITH PHASE LAYERS. G.G.Slyusarev.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 4, 780-3 (1957). In Russian.

The optical path connecting a point object to its image is not constant for a zone plate. A modified plate is described in which the path is kept constant for each zone and there is a phase change of 2π in going from one zone to the next. Such phase plates may be produced by depositing, on the surface of a lens, thin layers whose thickness varies according to a given law, or by a special polishing. It is shown that the defects of zone plates can be either fully avoided, or used in the compensation of the residual chromatic aberration of "ordinary" optical systems (secondary spectrum). S.Chomet

535.42 : 534.321.9

8541. THE DIFFRACTION OF LIGHT BY TWO PERPENDICULAR ULTRASONIC WAVES. P.Phariseau.
Physica, Vol. 23, No. 7, 651-6 (July, 1957).

A system of difference-differential equations is established. When the two ultrasonics have intensities of the same order of magnitude, it is proved that the integration of these equations is reduced to the integration of two systems which are of the Raman–Nath type for the diffraction by one ultrasonic wave. If the two ultrasonics have very different intensities, the equation becomes rather complicated. In this case it is still possible to reduce their integration to that of a system of the Raman–Nath type and to a more complicated one. A.

535.43 : 551.593

8542. NON-MOLECULAR SCATTERING IN THE UPPER LAYERS OF THE ATMOSPHERE. V.M.Morozov.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 5, 1039-42 (1957). In Russian.

Using a narrow searchlight beam, and a photomultiplier as the detector, the presence of non-molecular scattering of light was detected at altitudes up to 30-40 km above the earth's surface. S.Chomet

535.43

8543. A NEW METHOD FOR SOLVING MULTIPLE SCATTERING PROBLEMS IN INHOMOGENEOUS MEDIA. P.Gosar.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1437-55 (June, 1957).

The theory of the multiple small-angle scattering of waves (Abstr. 3176/1957) is extended to be applicable in the case of the inhomogeneous medium composed of the equal and centrally symmetrical scatterers embedded in an homogeneous medium. Further, a new method is developed for the numerical calculation of the angular distribution of the scattered waves. As an example the multiple scattering by dielectric spheres is discussed. In this case the angular distribution of the scattered waves is similar to the angular distribution of the electrons passing through thin metal foils. It proves that the mutual interaction of the spheres has an influence on the angular distribution, if the average distance between neighbouring spheres is of order of their diameter. A.

535.43 : 534.143

DIFFRACTION OF LIGHT BY VIBRATING QUARTZ.
See Abstr. 8468

535.435 : 537.531

8544. INFLUENCE OF MOLECULAR ORIENTATION ON X-RAY AND OPTICAL SCATTERING BY LIQUIDS. J.A.Prins and W.Prins.
Physica, Vol. 23, No. 3, 253-8 (March, 1957).

A general theory is formulated for the scattering of all wavelengths by anisotropic molecules, correlated in orientation. Different simplifications are then considered, with only a small gain for the X-ray case. From optical scattering data one gets the impression that "paratropic" liquids (tendency to parallel alignment) are the exception and "diatropic" (inverse tendency) the rule. A.

535.515 : 539.234

8545. EVIDENCE OF THE BIREFRINGENCE OF CALCIUM FLUORIDE THIN LAYERS, OBTAINED BY THERMAL EVAPORATION. P.Bousquet and Y.Delcourt.
J. Phys. Radium, Vol. 18, No. 7, 447-52 (July, 1957). In French.

A monochromatic light wave, rectilinearly polarized, reflected under incidence θ_1, on a thin layer, takes a phase alteration φ which depends on the orientation of the incident vibration. $\varphi_\perp$ and $\varphi_\parallel$ being the values corresponding to vibrations respectively perpendicular and parallel to the incidence plane, the difference $\varphi_\perp - \varphi_\parallel$ was measured, for different values of θ_1, of a series of thin calcium fluoride layers of different thicknesses. Important differences were found between experimental values of $\varphi_\perp - \varphi_\parallel$, and the values calculated from the optical constants of the layers. The differences are most important in the area of total internal reflection, specially near the critical angle for glass–fluoride. The only hypothesis able to explain those results seems to be a weak birefringence of the layers studied. They would act as negative uniaxial crystals, with optical axis perpendicular to their faces, the difference $n_O - n_e$ being about 2.5×10^{-3}. A.

535.557

8546. ON THE AVOIDANCE OF THERMAL EFFECTS IN THE MEASUREMENT OF FLOW BIREFRINGENCE. H.Janeschitz-Kriegl.
Physica, Vol. 22, No. 12, 1197-214 (Dec., 1956). In German.

In order to avoid the thermal perturbation of flow birefringence measurements a modified Couette apparatus was developed. In the usual apparatus the heat of friction generated in the liquid is removed by thermal conduction through the cylinder walls. As discussed by Björnståhl a stationary distribution of temperature is established showing a maximum at the centre of the gap. Consequently the light used in the measurements is refracted and is partly reflected by the cylinder walls. This perturbation severely limits the measurement of small flow birefringences. It may be avoided by superimposing a slow motion of the liquid parallel to the axis on the

main stream in the Couette apparatus. This convection current removes an important part of the heat of friction. Its consequences were studied theoretically and experimentally. Essential for the method proposed here is the use of glass cylinders. Indeed, the high thermal conductivity of metal walls suppresses the effect of a slow convection stream. A.

535.64

8547. NEW CHROMATICITY DIAGRAM. R.A.Houstoun.
J. Opt. Soc. Amer., Vol. 47, No. 7, 670-1 (July, 1957).

Starting with the assumption that the tristimulus values of a light on the C.I.E. colour system represent the degree of stimulation of three separate nerve systems, the author proposes a new set of equations for colour mixture, based on the assumption that a stimulus produces a group of charged particles in the retina. The new equations express respectively, conservation of mass, of momentum and of energy of the particles. This theory leads to a modified form of the C.I.E. diagram. J.W.T.Walsh

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.81

8548. INVESTIGATION OF THE OPTICAL CONTACT BETWEEN MICA AND GLASS. E.S.Trekhov.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 3, 550-2 (1957). In Russian.

Contrary to current opinion the author has found that it is possible to establish optical contact between mica and glass, provided (a) the mica laminae are sufficiently thin (ca. 5 μ) and are used directly after their cleavage in air, and (b) the glass surface is cleaned by high-frequency glow discharge and is kept in air $\geq$ 15 min before being used. The author distinguishes between two types of the mica–glass contact: (1) large contact surfaces; rectilinear boundary of contact break in the micro-region; the width of the interference O-band is constant when observed in reflected monochromatic light; this type of contact is rightly called homogeneous; (2) irregular form of contact break; variable curvature of the non-contacting lamina; variable width of the O-band; this non-homogeneous contact occurs more frequently than the homogeneous one, and is much more difficult to establish. It was found that cleaning with alcohol, distilled water or high-frequency glow discharge (with subsequent keeping in air for 15 min) resulted, as a rule, in contact (1), whereas treatment with point flame or glow discharge, followed immediately by contact-making, resulted, at best, in contact (2). Broken contact could be easily restored in the case (1), but only with great difficulty in the case (2). In the former case the phenomenon of "memory" was shown to exist in the contacting surfaces, leading to complete restoration of exactly the same contact as before. The (circular) "membrane" spots (gas bubbles) between glass and mica were all identical in (1), but varied in size in (2); the corresponding O-band widths were constant in (1) and variable in (2), even within the same membrane spot. It was calculated that, for (1), the ratio of the deflection of the membrane to the square of its diameter was constant, whereas it varied from one membrane to another in (2). The work of rupture of the contact (as calculated after Obreimoff, Proc. Roy. Soc. A, Vol. 127, 290, 1930) was 13 erg/cm^2 for the primary break of the glass–mica boundary; after a long-duration action of the rupturing deformation it gradually fell to about 9 erg/cm^2. F.Lachman

HEAT 536

536.2.02

8549. FORMULAS FOR THERMAL CONDUCTIVITY OF TERNARY GAS MIXTURES. B.N.Srivastava and S.C.Saxena.
J. chem. Phys., Vol. 27, No. 2, 583-4 (Aug., 1957).

The thermal conductivities of ternary mixtures of neon, argon, and krypton have been recently reported by the authors. In the present paper these values have been compared with those calculated from the two simple generalized expressions for the thermal conductivity of a ternary mixture, one of which is obtained from an extension of the Enskog's expression for the binary thermal conductivity while the other from the Lindsay–Bromley formula. It is found that the latter generalization yields values which are in better agreement with the experiment, provided the two constants of the Lindsay–Bromley formula are determined experimentally from binary conductivity. A.

536.2.08 : 537.311.33

MEASUREMENT OF THE THERMAL CONDUCTIVITY OF SEMICONDUCTORS. See Abstr. 7899

536.212 : 537.311.33

THERMAL CONDUCTIVITY OF BISMUTH TELLURIDE. See Abstr. 7900

536.212.2 : 537.311.31 : 536.48

8550. THE THERMAL AND ELECTRICAL CONDUCTIVITY OF CHROMIUM AT LOW TEMPERATURES. A.F.A.Harper, W.R.G.Kemp, P.G.Klemens, R.J.Tainsh and G.K.White.
Phil. Mag. (Eighth Ser.), Vol. 2, 577-83 (May, 1957).

The conductivities were measured over a wide range of temperature of specimens of pure chromium, both in the ductile and embrittled states. It has been found that the low temperature conduction properties are very similar to those of other transition metals investigated. At low temperatures the electrical resistance is mainly due to the scattering of electrons from the s-band to the d-band, while (s–s) scattering contributes about 60% of the thermal resistance. A.

536.212.2 : 537.311.31

8551. THERMAL AND ELECTRICAL RESISTIVITY OF SOME TUNGSTEN SINGLE CRYSTALS AT LOW TEMPERATURES AND IN STRONG MAGNETIC FIELDS. J.de Nobel.
Physica, Vol. 23, No. 3, 261-9 (March, 1957).

Using a single crystal with its length axis parallel to the (111) direction, the author was unable to separate the heat conductivity into the lattice and electronic components applying strong magnetic fields. Another single crystal parallel to the (100) direction was investigated down to 1.5° K, while in the liquid hydrogen region strong magnetic fields up to 36 kOc were also applied. It showed large anisotropy even amounting to 1.59. A.

536.212.2 : 537.311.31

8552. THERMAL AND ELECTRICAL CONDUCTIVITIES OF TUNGSTEN. EXPERIMENTAL RESULTS ON SINGLE CRYSTALS COMPARED WITH THEORY. J.de Nobel.
Physica, Vol. 23, No. 4, 349-58 (April, 1957).

Results of investigations of electrical and thermal conductivity of four tungsten single crystals are compared with theoretical considerations. From the relation between conductivities at constant temperature as a function of field strength an estimation of the lattice conductivity is made. Plots of wT (w = thermal resistance) versus T^3 gave straight lines for the four crystals with deviations at low temperature. The temperature and field dependence of the Wiedemann–Franz–Lorenz parameter and of the electrical resistance are considered. Kohler diagrams for the electrical resistance as well as for the thermal resistance are given. A.

536.241

8553. THE THERMAL CONDUCTANCE OF CONTACTS BETWEEN ALUMINIUM AND OTHER METALS.
F.Boeschoten and E.F.M.van der Held.
Physica, Vol. 23, No. 1, 37-44 (Jan., 1957).

The coefficient of heat transfer of a joint between aluminium and aluminium, steel and uranium respectively was measured. The gap between the metal surfaces was filled with air, helium or hydrogen of gas pressures varying between 1 mm Hg and 750 mm Hg. Some oils also were introduced in the joint. The temperature of the joint was in all experiments about 150° C. It appears that at low contact pressures of several kg cm^{-2} the heat conduction takes place principally through the gas in the gap, whereas at higher contact pressures the metallic contact spots contribute more and more to the conductance. This is in agreement with the measurements of Weills and Ryder. Calculation of the thickness of the gap from heat conductance measurements is in rough agreement with roughness measurements with a profilometer and a microscope. An estimation is made of size and the number of the metallic contact spots, using the theory for electric contacts of Holm and others. From thermal conductance and hardness measurements the average radius of the contact spots is found to be about 30μ, whereas about 100 of such spots may be found per square centimetre at a contact pressure of 35 kg cm^{-2}. The contact pressure has not much influence on the size of the contact spots, but their number varies proportionally with the contact pressure. Above a certain value of the contact pressure a confluence of the contact spots takes place and a decrease of their number. Moreover it seems that the size of the contact spots is independent of the metals by which the joint is formed, a value of about 30μ being found for a greater variety of metals, such as aluminium, uranium, steel, copper, nickel and graphite, under different circumstances, regarding the applied contact pressure and the size and the

shape of the joints. This independence of the size of the contact spots of the contact pressure and the materials of the joint, makes it possible to estimate the coefficient of heat transfer of arbitrary metallic joints. A.

536.27 : 532.25

8554. THE THERMAL INSTABILITY OF A ROTATING FLUID SPHERE HEATED WITHIN. S.Chandrasekhar.
Phil. Mag. (Eighth Ser.), Vol. 2, 845-58 (July, 1957).

The equations governing the state of marginal instability are derived for the case when the motions and the associated perturbations have symmetry about the axis of rotation. The underlying characteristic value problem is solved for a slightly modified set of boundary conditions. Nevertheless, the solution obtained suffices to determine the general nature of the dependence of the lowest Rayleigh number for the onset of instability on the Taylor number $T(= 4\Omega^2R^4/\nu^2)$. A.

536.33 : 530.162

8555. THE INFLUENCE FUNCTION IN THE THEORY OF RADIANT ENERGY TRANSFER. B.B.Kadomtsev.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 3, 541-3 (1957). In Russian.

The propagation of radiation may be specified as a stochastic process in terms of standard equations if all the relevant data, such as scattering and re-absorption coefficients, are given. This formulation is facilitated by using an "influence function" of the stochastic variables of adjacent (Markov) states. J.W.Gardner

536.413

8556. THE THERMAL EXPANSION OF SOLIDS. G.C.Fletcher.
Phil. Mag. (Eighth Ser.), Vol. 2, 639-48 (May, 1957).

The assumptions involved in two well-known formulae due to Grüneisen are investigated and with these assumptions an explicit formula for the volume of a solid as a function of temperature is derived. Application is made to the case of KCl and the results compared with experiment with a view to deciding whether defects are present at high temperatures. Defects in the theory and a previous investigation by Fischmeister are discussed. A.

536.413 : 548.7

8557. INFLUENCE OF VACANCIES ON THE THERMAL EXPANSION OF LEAD NEAR THE MELTING POINT.
J.van Duijn and J.van Galen.
Physica, Vol. 23, No. 7, 622-4 (July, 1957).

The thermal expansion is measured for Pb from room temperature to 300°C by two methods: dilatometric and with X-rays. No difference is found. This result is either due to the concentration of vacancies being too small at high temperature or to the influence of vacancies on the lattice parameter as calculated by Eshelby. A.

536.413

8558. ON THE THERMAL EXPANSION OF SOLIDS.
M.Blackman.
Proc. Phys. Soc. B, Vol. 70, Pt 9, 827-32 (Sept., 1957).

The thermal expansion of alkali halides has been investigated at very low temperatures and at high temperatures. Attention has been concentrated on the isotropic cases, for which a formal expression for the Grüneisen constant has been obtained. It is shown that the Grüneisen constant is expected to increase somewhat as the temperature is increased. It is further shown that the contributions from the individual vibrations to the Grüneisen constant at low temperatures vary over a very wide range. The Grüneisen rule, however, is shown to require only that a certain average value of these contributions should not vary with frequency. A.

536.413 : 548.736.3

COEFFICIENTS OF THERMAL EXPANSION IN LEUCO-SAPPHIRE AND RUBY. See Abstr. 8298

536.424 : 536.421 : 539.893

POLYMORPHIC TRANSITIONS OF BISMUTH AT VERY HIGH PRESSURES. See Abstr. 8228

536.48 : 538.222

8559. THE THERMAL AND MAGNETIC PROPERTIES OF YTTERBIUM ETHYL SULPHATE BETWEEN 20°K AND 1°K.
A.H.Cooke, F.R.McKim, H.Meyer and W.P.Wolf.
Phil. Mag. (Eighth Ser.), Vol.2, 928-35 (July, 1957).

The susceptibility of a single crystal of ytterbium ethyl sulphate has been measured between 20°K and 1°K. Below 4°K the results obeyed the relations $\chi_{\parallel} = 1.08/T$ per mol, and $\chi_{\perp} = 0.061_5$ per mol. These measurements served to identify the ground doublet state of the ytterbium ion in this case as $J = \frac{7}{2}$, $J_Z = \pm\frac{7}{2}$. The magnetic specific heat was measured at five temperatures between 3°K and 1°K by the relaxation method. The results were given by $CT^2/R = 4.34 \times 10^{-4}$, in agreement with calculations based on dipole-dipole and hyperfine interactions alone. The spin lattice relaxation time τ was also measured. At 3°K, $\tau \cong 5 \times 10^{-4}$ sec and was very temperature dependent. Susceptibility measurements above 4°K indicated the population of excited states, which could not be unambiguously identified. Their separation from the ground state was at least 57°K. A.

536.48

8560. THE OSMOTIC PRESSURE OF LIQUID ^{3}He–^{4}He MIXTURES AT TEMPERATURES BELOW THE LAMBDA-POINT.
D.H.N.Wansink and K.W.Taconis.
Physica, Vol. 23, No. 2, 125-39 (Feb., 1957).

The osmotic pressure of liquid He^3–He^4 mixtures, condensed in a vessel connected by means of a narrow slit to a similar vessel containing pure He^4, has been measured by determining the fountain pressure exerted by the pure He^4, when heated, necessary to obtain equilibrium with the osmotic pressure of the mixture. The osmotic pressure meets Van't Hoff's law within a few percent up to 4% concentration. A revised vapour-pressure – liquid-concentration relation is given, based on the results, obtained at 1.2°K. A.

536.48

8561. CALCULATION OF THERMODYNAMIC QUANTITIES OF ^{3}He–^{4}He MIXTURES FROM THE VAPOUR PRESSURE AT TEMPERATURES BETWEEN 1.2 AND 1.9°K. D.H.N.Wansink.
Physica, Vol. 23, No. 2, 140-53 (Feb., 1957).

On the basis of the vapour pressure of He^3–He^4 mixtures, partly measured directly by Sommers and by Wansink et al. and partly calculated from the osmotic pressure data obtained by Wansink and Taconis (preceding abstract), the change of the Gibbs-function of the mixture with concentration has been calculated in the temperature region between 1.2 and 1.9°K at concentrations up to 7% He^3. The entropy, enthalpy and specific heat of mixing are given in comparison with experimental data. The phase separation at low temperatures and the mechanocaloric effect of He^3–He^4 mixtures are calculated. A.

536.48 : 536.632

8562. NEW EXPERIMENTS ON THE SPECIFIC HEAT OF LIQUID ^{4}He BELOW 0.7°K.
J.Wiebes, C.G.Niels-Hakkenberg and H.C.Kramers.
Physica, Vol. 23, No. 7, 625-32 (July, 1957).

New measurements indicate that the previous data of Kramers, Wasscher and Gorter were actually somewhat too large in the phonon region. The discrepancy which existed with the phonon specific heat as calculated from the velocity of sound has now been removed. A.

536.48

8563. ON THE PROBLEM OF THE STATIC HELIUM FILM. II. EFFECTS DUE TO THE SMALLNESS OF ONE DIMENSION.
S.Franchetti.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 183-202 (Jan., 1957).

For Pt I, see Abstr. 2127 (1957). Some aspects of the thermodynamical behaviour of certain fluids when they are made to occupy very flat spaces (their density being held constant) are investigated. The zero point energy change of liquid He^4 (a problem first considered by K.R.Atkins) is studied on the basis of two different models. The changes in the internal energy and in the free energy of two types of Bose–Einstein perfect gases in a state of partial condensation are analysed. A.

536.48

8564. ON THE PROBLEM OF THE STATIC HELIUM FILM. III. THE PROFILE OF THE FILM AND ITS DEPENDENCE ON TEMPERATURE. S.Franchetti.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1266-80 (May, 1957).

The profile of the film and its dependence on temperature, both below and above the λ-point, are studied on the basis of the results reached in Pt I and II (see preceding abstract). The conclusions appear to be in fair agreement with experiment. The thermodynamic condition for film formation under the action of Van der Waals forces, is also discussed and found to be fulfilled. A.

536.48 : 534.22

VELOCITY OF ULTRASONIC WAVES IN HELIUM AT 1°K. See Abstr. 8470

536.48 : 537.312.62

8565. QUANTUM FLUID AS A COMMON MODEL FOR SUPERFLUIDITY AND SUPERCONDUCTIVITY. N.Mikoshiba.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 628-39 (March, 1957).

Some dynamical properties of a quantum fluid as a simple

common model for superfluidity and superconductivity are studied. Comparison with another common model i.e. an ideal Bose gas is made. The connection theorem proved by Schafroth in the case of many-particle systems is proved also in the case of quantum fluid. By the theorem Landau's equation of superfluidity and London's equation of superconductivity can be verified for quantum fluid. A.

536.48 : 532.133

8566. THE VISCOSITY OF THE NORMAL PART OF LIQUID HELIUM II FROM HEAT CONDUCTION EXPERIMENTS. A.Broese van Groenou, J.D.Poll, A.M.G.Delsing and C.J.Gorter.
Physica, Vol. 22, No. 10, 905-10 (Oct., 1956).

The measurements of Winkel, Broese van Groenou and Gorter on the heat conduction in liquid helium II have been extended to lower temperatures. At 1.1 and 1.2°K the heat conduction still appears to be proportional to the cube of the slit width in not too narrow slits. The viscosity computed from these data thus appears to have physical significance. There is a tendency for the viscosity to rise at the lowest temperatures but this effect is not so pronounced as has been found in oscillating disk and rotating viscometer experiments. No Knudsen or Klemens effects have been found. A.

536.48

8567. THE FLOW PROPERTIES OF PURE ^{4}He AND OF ^{3}He–^{4}He MIXTURES AT TEMPERATURES BELOW THE LAMBDA-POINT. D.H.N.Wansink and K.W.Taconis.
Physica, Vol. 23, No. 4, 273-305 (April, 1957).

The flow through a slit with a width of 0.3 micron as a function of hydrostatic pressure heads up to 7000 cm He and fountain pressure differences up to 2500 cm He has been studied. It is concluded that the flow resistance is proportional to the slit length. Values of the normal fluid viscosity, of the normal fluid fraction and of the lambda-point temperature as a function of the He^3 concentration are given. The volume contraction on mixing the two isotopes is estimated. A.

536.48

8568. THE THICKNESS OF THE SATURATED HELIUM FILM ABOVE AND BELOW THE λ-POINT. A.C.Ham and L.C.Jackson.
Proc. Roy. Soc. A, Vol. 240, 243-64 (May 21, 1957).

The properties of the static helium film covering a vertical, polished metal surface, at heights between 0.4 and 1.6 cm above bulk liquid and from 1.2 to 3.8°K, have been reinvestigated using an improved form of apparatus based on the optical method of Burge and Jackson (1951). The original calibration curve of the instrument was found to be incorrect by about 30%, and an entirely new one has been constructed in which the only assumption is that the refractive indices of film and bulk liquid are the same. At 2.05°K the film thickness d is given by $d = k/H^{1/z}$, where H is the height above bulk liquid, $k = 3.15 \times 10^{-6}$ cm and z = 2.3. The value of z increases to about 2.6 as the temperature falls to 1.32°K, but at temperatures below 2.05°K it varies slightly with height. The value of k varies little between 1.2 and 3.8°K, and it is has been shown that the film is essentially the same above and below the λ-point. This confirms the theories of the film which are based primarily on van der Waals's forces of attraction, and it seems clear that the existence of the film is not connected with the λ-phenomenon. Below the λ-point a thin layer of solid air on the metal surface increases the static film thickness enormously. Above the λ-point this phenomenon does not occur, but extreme temperature homogeneity is necessary in order that the film may form. The differences between these results and those of other investigations of the film are discussed. A.

536.48 : 537.312.62

8569. SUPERFLUIDITY AND SUPERCONDUCTIVITY. R.P.Feynman.
Rev. mod. Phys., Vol. 29, No. 2, 205-12 (April, 1957).

International Congress review paper (see Abstr. 5814/1957). He^4 is qualitatively understood on the basis of Bose–Einstein condensation and the excitation of phonons and rotons, but one has not yet found exact wave-functions for these, nor can the ground state be derived from first principles. The energy of a roton has been worked out theoretically (11.5°K) (Abstr. 5820/1956) and agrees fairly well with experiment (9.6°K). A simple explanation is given why in vortex flow the vorticity is quantized and is concentrated along certain lines of one unit each. Superconductivity is a more difficult problem because the energies involved are very much smaller than the electron energies and the de Broglie wavelength corresponding to the energy of transition is much larger than the lattice spacing. The property to be explained is that the ground state is separated from the higher excited states by a region where the density of states is low. Then the thermodynamic and electrodynamic properties would follow. In looking for the long-range interaction that causes the energy gap, the author recommends the Fröhlich–Bardeen interaction through the lattice, because of the isotope effect, but believes that complicated band structure and the presence of positive holes, which is peculiar to all superconductors, also plays its part. He does not think that further refinement of perturbation theory will give the answer, as it is likely that the superconducting ground state is qualitatively different from the normal ground state. Thus one will have to guess what kind of correlation exists at long distances. H.London

536.5.081.4

8570. THE TRIPLE POINTS OF CARBON DIOXIDE AND OF ARGON AS FIXED POINTS FOR THE CALIBRATION OF THERMOMETERS. A.Michels, T.Wassenaar, T.Sluyters and W.de Graaff.
Physica, Vol. 23, No. 2, 89-94 (Feb., 1957).

The International Temperature Scale for resistance thermometers is defined with the help of a number of fixed points, at which thermometers should be calibrated. In the temperature region below 0°C the definition, which is now valid, is not satisfactory. In the present paper it is proposed to introduce the triple points of carbon dioxide and of argon as fixed points. An instrument is described in which those triple points can be realized and maintained long enough for calibration purposes. Some data are given which show that the reproducibility is of the order of 0.001 deg C. A.

536.62 : 537.534

DESIGN OF CALORIMETERS FOR THE DETERMINATION OF ION BEAM INTENSITIES. See Abstr. 7967

536.628.2 : 539.16.08

CONSTRUCTION OF AN AUTOMATIC DEVICE FOR ADIABATIC MICROCALORIMETRY. See Abstr. 8118

536.631

8571. SPECIFIC HEAT OF CHAIN STRUCTURES AT LOW TEMPERATURES. I.V.Sochava and O.N.Trapeznikova.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 4, 784-6 (1957). In Russian.

The specific heats C of (I) polyethylene, (II) polyvinyl alcohol and (III) glass "23" are tabulated at 5°K intervals, (I) and (III) from 58 to 270°K and (II) from 58 to 245°K. Curves of log C against log T (T = temperature) are given for (I) and (II) and discussed in relation to the formula $C = AT^m$ with special reference to the variation of m with temperature. R.F.S.Hearmon

536.631

8572. HEAT CAPACITY OF HOLMIUM FROM 15 TO 300°K. B.C.Gerstein, M.Griffel, L.D.Jennings, R.E.Miller, R.E.Skochdopole and F.H.Spedding.
J. chem. Phys., Vol. 27, No. 2, 394-9 (Aug., 1957).

The heat capacity has been measured and two maxima have been observed which occur at 19.4 and 131.6°K. The one at the lower temperature exhibits a dependence on the thermal history of the sample and this dependence was investigated. The thermodynamic functions have been tabulated and a correlation made of the contributions to the entropy at room temperature. The value of $S^0_{298.16}$ is 17.97 cal $(^0K)^{-1}$ (g atom)$^{-1}$ to which the magnetic contribution is R ln(2J + 1). A.

536.631 : 538.222 : 536.48

8573. THE SPECIFIC HEATS AND MAGNETIC SUSCEPTIBILITIES OF ALLOYS OF CERIUM WITH LANTHANUM AT LOW TEMPERATURES. L.M.Roberts and J.M.Lock.
Phil. Mag. (Eighth Ser.), Vol. 2, 811-19 (June, 1957).

Specific heat measurements between 1.5°K and 20°K, and magnetic susceptibility measurements between 1.5°K and 290°K have been made on four alloys containing respectively 78.9%, 37.6%, 27.0% and 5.03% by weight of cerium in lanthanum. Comparison is made with similar previous measurements on pure cerium. The single anomaly in the specific heat of pure cerium at 12.3°K splits into two in the alloys, and as the dilution is increased these anomalies move to lower temperatures. The lower of the two only is accompanied by a change in the magnetic properties, a maximum occurring in the susceptibility of the most concentrated alloy and temperature-independent paramagnetism setting in suddenly in the next two. In the most dilute alloy the anomalies in both the specific heat and in the susceptibility appear to have moved to temperatures below 1.5°K. Above 80°K the magnetic susceptibilities of all the alloys obeyed a Curie–Weiss law, $\chi = C/(T - \theta)$. The Curie constant C varied smoothly from 56.1×10^{-4} e.m.u./g Ce for the most concentrated alloy (cf. 55.3×10^{-4} e.m.u./g for pure cerium) to about

140×10^{-4} e.m.u./g Ce for the most dilute alloy. As in pure cerium, antiferromagnetism is believed to be the explanation of the anomalous magnetic behaviour of the alloys. However, the double specific heat anomalies in the latter suggest that the ordering of the 4f electronic orbitals takes place in two stages, while the temperature-independent paramagnetism of the more dilute alloys may be the consequence of freedom of the direction of magnetic ordering to orient itself perpendicular to the applied field. The increase in the Curie constant suggests that the population of the 4f shell increases, with dilution of the alloys, to 2 or 3 electrons per atom of cerium. A.

536.631 : 536.48

8574. HEAT CAPACITY OF PALLADIUM BELOW 4.2°K.
J.A.Rayne.
Phys. Rev., Vol. 107, No. 3, 669-70 (Aug. 1, 1957).

Heat capacity measurements below 4.2°K have been made on extremely pure palladium. The resulting values of electronic heat capacity and Debye temperature differ from previous work, it being found that $\gamma = (9.87 \pm 0.11) \times 10^{-3}$ joule mole^{-1} deg^{-2} and $\theta = 299 \pm 12$°K. The effects of changes in the physical and chemical state of the specimen have been investigated with a view to understanding the discrepancies between the various determinations of the low-temperature atomic heat of palladium. A.

536.631

8575. THE ATOMIC HEATS OF CALCIUM, STRONTIUM AND BARIUM BETWEEN 1.5° AND 20°K. L.M.Roberts.
Proc. Phys. Soc. B, Vol. 70, Pt 8, 738-43 (Aug., 1957).

The atomic heats were measured with the primary object of obtaining values for the electronic contributions to the specific heats. In all three metals at the lowest temperatures an atomic heat of the form $C = AT + 1943(T/\Theta)^3$ joule deg^{-1} (g atom)$^{-1}$ is found, where A and Θ are respectively $(2.73 \pm 0.06) \times 10^{-3}$ and 228.9 ± 1.7°K for calcium, $(3.64 \pm 0.18) \times 10^{-3}$ and 147.0 ± 1.2°K for strontium and $(2.7 \pm 0.5) \times 10^{-3}$ and 110.5 ± 1.8°K for barium. The experimental values of A, which represent the electronic contribution to the atomic heat, are compared with those calculated on the basis of the Sommerfeld free-electron model, and are found to be between 1.4 and 2.0 times as great indicating a considerable overlapping of the first two Brillouin zones. Smoothed values of the atomic heats are tabulated at intervals up to 20°K and the variations of Θ with temperature are shown graphically. The internal energies, entropies and free energies are also tabulated. A.

536.631

8576. THE ATOMIC HEATS OF LITHIUM, SODIUM AND POTASSIUM BETWEEN 1.5° AND 20°K. L.M.Roberts.
Proc. Phys. Soc. B, Vol. 70, Pt 8, 744-52 (Aug., 1957).

The atomic heats were measured chiefly with the object of determining the effective mass of the conduction electrons. For lithium it was found that, below 4°K, the atomic heat could be written as $C = (0.418T + 0.0092T^3) \times 10^{-3}$ cal mol^{-1} deg^{-1}, corresponding to an effective mass m* for the conduction electrons of 2.32 times the free electron mass m_0, and a Debye characteristic temperature Θ for the lattice of 369°K. Near 15°K a small anomaly in the atomic heat was observed. For sodium below 4.5°K the atomic heat was of the form $C = (0.328T + 0.117T^3) \times 10^{-3}$ cal mol^{-1} deg^{-1}, corresponding to $m^* = 1.22m_0$ and $\Theta = 158$°K, and no anomalies were found. For potassium it was not possible to analyse the atomic heat so exactly, but a value of m* of about $1.1m_0$ is estimated, with $\Theta = 89$°K. Smoothed values of the atomic heats are tabulated at intervals up to 20°K, and calculated values of Θ are given graphically. The internal energy, entropy and free energy are also tabulated. A.

THERMODYNAMICS 536.7/.8

536.7

8577. DENSITY EXPANSIONS OF DISTRIBUTION FUNCTIONS. I. VIRIAL EXPANSION FOR FINITE CLOSED SYSTEMS; CANONICAL ENSEMBLE. I.Oppenheim and P.Mazur.
Physica, Vol. 23, No. 3, 197-215 (March, 1957).

A method is presented which enables one to obtain density expansions for the distribution functions for finite systems from integro-differential equations involving derivatives of these distribution functions with respect to density. It is shown that the λ^{th} coefficient in the density expansion is a polynomial in 1/N of degree λ. Explicit algebraic recursion relations are obtained for these coefficients. The results obtained are derived under the assumption of periodic boundary conditions and a study of this concept is given. A.

536.7

8578. DENSITY EXPANSIONS OF DISTRIBUTION FUNCTIONS. II. DENSITY EXPANSIONS IN THE GRAND CANONICAL ENSEMBLE. P.Mazur and I.Oppenheim.
Physica, Vol. 23, No. 3, 216-24 (March, 1957).

The techniques of the grand canonical ensemble are used to obtain density expansions for distribution functions from integro-differential equations involving derivatives of these functions with respect to density. The results apply to classical and quantum systems. A product condition for the distribution functions is obtained. A.

ELECTRICITY 537

537.122

8579. A METHOD FOR CALCULATING THE ANOMALOUS MAGNETIC MOMENT OF THE ELECTRON.
S.Kahana and J.C.Polkinghorne.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1528-32 (June, 1957).

A method is outlined, making use of zero-photon-energy uncrossed Compton scattering diagrams. It is illustrated by a calculation of the Schwinger term. A.

ELECTROSTATICS. DIELECTRICS 537.2

537.226.1

8580. REMARK ON THE CALCULATION OF THE STATIC DIELECTRIC CONSTANT. H.Fröhlich.
Physica, Vol. 22, No. 10, 898-904 (Oct., 1956).

Macroscopic relations are derived between the dielectric constant and the fluctuations of the dipole moment of a substance. They can be used as a basis for a microscopic calculation of the dielectric constant. For an appropriate model this confirms Onsager's equation. A different relation, derived by Harris and Alder and by Harris, is shown to be incorrect because these authors start from a wrong macroscopic relation. A.

537.226.1

8581. DIELECTRIC BEHAVIOUR OF ORGANIC LIQUID–WATER MIXTURES. G.P.Srivastava and Y.P.Varshni.
Physica, Vol. 23, No. 2, 173-8 (Feb., 1957).

An equation is suggested for the variation of dielectric constant of mixture of polar liquids with concentration c and temperature T (deg K): $\epsilon = (1 + m/T) + (p + q/T^{1/2})c + Zc^2$ where l, m, p, q and Z are constants. When variation of ϵ with c is linear, only first two terms are sufficient. The equation has been illustrated for water-methyl alcohol and water-tert.–butyl alcohol mixtures with satisfactory results. A.

537.226.1 : 533.7

8582. THE INFLUENCE OF A STRONG MAGNETIC FIELD ON THE DIELECTRIC CONSTANT OF A DIAMAGNETIC FLUID. A.D.Buckingham.
Proc. Phys. Soc. B, Vol. 70, Pt 8, 753-60 (Aug., 1957).

The effect of a strong magnetic field on the static dielectric constant of a diamagnetic fluid is investigated using statistical mechanical methods; a formula is derived relating the dielectric constant ϵ to the square of the field strength. The theory indicates that the change in ϵ is very small in non-polar substances (although it is detectable in magnetic double refraction experiments), but should be measurable in polar liquids; it is known to be substantial in "liquid crystals", and it is suggested that it might also be large in solutions of large molecules. In a polar substance the chief contributor to the change in ϵ is related to the anisotropy in the diamagnetic susceptibility tensor and is proportional to the square of the molecular electric dipole moment. Relationships between the effect and electric and magnetic double refraction are established. Experimental data is scanty, but it is indicated how observations of the effect could lead to information about molecular properties. A.

537.226.1

8583. FORMULAE FOR DIELECTRIC CONSTANT OF MIXTURES. J.A.Reynolds and J.M.Hough.
Proc. Phys. Soc. B, Vol. 70, Pt 8, 769-75 (Aug., 1957).

The major formulae suggested for the dielectric constant of a mixture of two components (at least one of which has the form of particles containing many molecules) are shown to be all related to another. The assumptions made in deriving the differing formulae are examined. The type of formula suggested by Lichtenecker does not fit in this generalization and it is suggested that this is due to incorrect theoretical assumptions. A.

537.226.1

8584. THEORY OF ROCHELLE SALT. A.F.Devonshire.
Phil. Mag. (Eighth Ser.), Vol. 2, 1027-39 (Aug., 1957).

Masons's theory of Rochelle salt is critically examined in relation to Bancroft's high-pressure measurements of the dielectric constant. It is shown that, though the theory as it stands cannot explain the results, it can be made to do so fairly well by a slight modfication. The theory, however, requires the effective dipole moment to vary with volume in an unexpected way, and no satisfactory explanation has been found for this. A.

537.226.1

8585. DYNAMIC THEORY OF IONIC LATTICES OF FERROELECTRIC CRYSTALS UNDER STATIC CONDITIONS. V.Kh.Kozlovskiĭ.
Zh. tekh. Fiz., Vol. 26, No. 5, 963-76 (1956). In Russian.

A theory of one-dimensional anharmonic vibrations of ferroelectric ions, with and without an external field, is given. A criterion for spontaneous polarization is established. Ferroelectrics are subdivided into two kinds, the first characterized by a type I phase transition and temperature hysteresis, and the second by a type II phase transition. Qualitative agreement with existing X-ray data is obtained. The dielectric constant above the phase transition temperature obeys a Curie—Weiss law, whereby it has a pole at a temperature different from the phase transition temperature. It is shown that the hysteresis loop of the type I ferroelectrics changes shape near the transition temperature. J.B.Arthur

537.226.1 : 548.1

FERROELECTRIC PHASE TRANSITIONS AND CRYSTAL SYMMETRY. See Abstr. 8254

537.226.2

8586. THE COMPLEX PERMITTIVITY OF LIQUID HALOGEN-SUBSTITUTED BENZENES AND OF SOME ALCOHOLS AT MM-WAVELENGTHS. F.W.Heineken and F.Bruin.
Physica, Vol. 23, No. 1, 57-62 (Jan., 1957).

Small deviations from the Debye circle, as observed by Poley at a wavelength of 8 mm, are confirmed by measurements from 7.5 to 3 mm wavelength and explained on the basis of rotational transitions. Power at different wavelengths is generated by 1N26 crystal multipliers being excited by a 2K33 or a QK306 klystron. The sample fills the space between a thin mica window and a movable piston in a rectangular silver waveguide. The data are obtained from the standing wave ratio in front of the window. A.

537.226.2 : 537.311.33

8587. AN INVESTIGATION OF THE DIELECTRIC CONSTANT OF SEMICONDUCTORS.
É.I.Kir'yashkina, F.M.Popov, D.I.Bilenko and V.I.Kir'yashkin.
Zh. tekh. Fiz., Vol. 27, No. 1, 85-9 (1957). In Russian.

(1) Powder compacts were made with various pressures of the following high-resistivity semiconductors: WO_3, PbO, CuO, Ni_2O_3, Co_2O_3, ZnO, V_2O_5, Cu_2O, Na_2WO_4. For each its dielectric constant (ϵ) as measured in the centimetre region and the variation of ϵ with formation pressure (i.e. with density) are tabulated. For comparison, the table includes ϵ for Cu_2O prepared by direct oxidation and measured in the same apparatus. (2) By means of a method involving the measurement of ϵ for a mixture of semiconductor with a pure dielectric, ϵ was measured for the following high-conductivity semiconductors: ZnS, CdS, ZnSe, ZnTe, CdSe, CdTe, HgS, HgSe, HgTe, SnSb. Results are also given in tables.
A.F.Brown

537.226.2

8588. ELECTRICAL CONDUCTIVITY OF CERAMIC MATERIALS IN STRONG ELECTRIC FIELDS. I.E.Balygin and N.T.Plashchinskiĭ.
Zh. tekh. Fiz., Vol. 27, No. 1, 138-46 (1957). In Russian.

Using a guard-ring method with the specimen in the form of a tubular condenser, measurements were made of the variation of electrical conductivity with applied voltage for various temperatures in the range 23-489°C. It is concluded that conductivity relation $\sigma = f(E)$ does not apply for the radio-ceramic dielectrics studied, viz. "ultraporcelain", spinel SH-15, "thermocond" T-20, "ticond" T-75 and "ticond" T-80. Ohm's law is observed with porcelain up to about 300°C. For material T-75 σ varies relatively markedly with applied field. With T-80 there occurs a sharp drop in the current 10-30 μsec after application of the voltage presumably due to a space-charge effect in the ceramic. C.R.S.Manders

537.226.8

8589. DEPENDENCE OF ELECTRIC STRENGTH OF IONIC CRYSTALS ON TEMPERATURE. V.D.Kuchin.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 2, 301-3 (1957). In Russian.

Experimental results are reported for electric strength of NaCl, KBr, KCl, and KI as affected by temperature between −130 and +150°C, and by duration of electric impulse between 10^{-4} and 10^{-8} sec. The results are compared with theory, particularly that of Fröhlich and Paranjape (Abstr. 2144/1956). R.F.S.Hearmon

537.226.8

8590. EFFECT OF PLASTIC DEFORMATION ON THE DIELECTRIC BREAKDOWN OF SILVER CHLORIDE CRYSTALS. N.Itoh and T.Suita.
J. Phys. Soc. Japan, Vol. 12, No. 2, 214 (Feb., 1957).

A rectangular voltage pulse (10 c/s) rising at the rate of 3 kV/min was applied via hollow electrodes to specimens locally stressed (250 kg/cm^3) at the positive or negative electrode. The increase in breakdown voltage was greater in the latter case than the former. J.E.Caffyn

537.226.8

8591. THE ELECTRIC STRENGTHS OF GLASSES WITH DIFFERENT SODIUM CONTENTS. J.Vermeer.
Physica, Vol. 22, No. 12, 1247-53 (Dec., 1956).

A comparison is given of the electric strengths of four kinds of glass with different sodium contents, measured at temperatures between −183°C and +200°C, using approximately linearly rising voltages of durations between 30 sec and 10^{-5} sec. The reproducibility of the measurements was within $2\frac{1}{2}$%. The values of the intrinsic electric strength ranged from 9 MV/cm to 11.5 MV/cm. No correlation with the ionic conductivities was found in accordance with the electronic nature of the intrinsic breakdown, which is generally accepted. No effect of specimen thickness, temperature, voltage rise time or electrode material was found. On the other hand if the temperature was high enough and the voltage duration long enough to permit motion of ions a breakdown strength was found decreasing with specimen thickness, temperature and voltage duration. Thin silver electrodes gave lower values than liquid electrodes. In this region the glass with the highest sodium content showed the smallest breakdown strength and conversely. This means a support for the supposition that here ions play a dominating part. A.

537.226.8

8592. ON THE RELATION BETWEEN IONIC CONDUCTIVITY AND BREAKDOWN STRENGTH OF GLASS. J.Vermeer.
Physica, Vol. 22, No. 12, 1269-78 (Dec., 1956).

In the region where the breakdown strength of glass decreases with increasing temperature and with increasing voltage duration, the breakdown was assumed to be of thermal nature. On the basis of this assumption it was possible to calculate quantitatively the absolute values of the breakdown strengths and its dependence on temperature and on voltage rise time to the right magnitude for four kinds of glass, taking into account the results of measurements of the effect of temperature and of field strength upon the ionic conductivities, reported in Abstr. 8600 (1957). In an intermediate region between thermal and intrinsic breakdown, higher breakdown strengths were measured than predicted by the theory of thermal breakdown. Time lag of the ions with regard to the rapid field variation on the one hand and space charge distortion of the field on the other hand can account for this fact. A.

537.226.8

8593. STATISTICAL LAG IN ELECTRICAL BREAKDOWN OF SOLID DIELECTRICS. E.A.Konorova.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 603-4 (1957). In Russian.

The electrical strength of mica and glass was determined as a function of thickness (2 to 10μ) and duration of voltage impulse (10^{-2} to 10^{-8} sec). The results are in agreement with theories of electrical strength due to Seitz (Abstr. 3173/1950) and others.
R.F.S.Hearmon

537.228.2 : 537.226.2 : 536.413

8594. INVESTIGATION OF ELECTROSTRICTION IN FERROELECTRIC CERAMICS. T.N.Verbitskaya.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 3, 533-6 (1957). In Russian.

Four solid solutions in the system $Ba(Ti,Sn)O_3$ were investigated. Data are given for the dependence of electrostructive extension, electrical capacitance and thermal expansion coefficient on field strength and temperature. R.F.S.Hearmon

ELECTRIC CONDUCTION. CURRENTS 537.3

537.311.1

8595. SPATIAL VARIATION OF CURRENTS AND FIELDS DUE TO LOCALIZED SCATTERERS IN METALLIC CONDUCTION. R.Landauer.
I.B.M. J. Res. Developm., Vol. 1, No. 3, 223-31 (July, 1957).

Localized scatterers can be expected to give rise to spatial variations in the electric field and in the current distribution. The transport equation allowing for spatial variations is solved by first considering the homogeneous transport equation which omits electric fields. The homogeneous solution gives the purely diffusive motion of current carriers and involves large space charges. The electric field is then found, and approximate space charge neutrality is restored, by adding a particular solution of the transport equation in which the electric field is associated only with space charge but not with a current. The presence of point scatterers leads to a dipole field about each scatterer. The spatial average of a number of these dipole fields is the same as that obtained by the usual approach which does not explicitly consider the spatial variation. Infinite plane obstacles with a reflection coefficient r are also considered. These produce a resistance proportional to $r/(1-r)$. A.

537.311.1 : 538.632

8596. THE LINEAR HALL EFFECT. P.J.Price.
I.B.M. J. Res. Developm., Vol. 1, No. 3, 239-48 (July, 1957).

A new method for handling the Boltzmann equation is used to obtain, without approximation, a general formula for the linear Hall effect in a solid electronic conductor. Expressions for the conductivity in no magnetic field and for the quadratic magnetoconductivity are also obtained. These formulae introduce a vector mean free path, not in general parallel to the electron velocity, which is related to the velocity by an integral equation. Some possible cases of the formula for the Hall effect are analysed. The solution of the integral equation for the vector mean free path is discussed, and methods of approximation are proposed. A.

537.311.1

8597. A NEW APPROACH TO THE THEORY OF ELECTRICAL CONDUCTIVITY OF SOLIDS. B.Meltzer.
Physica, Vol. 23, No. 2, 118-24 (Feb., 1957).

Since the electrical conductance of a body is a measure of the fluctuations of charge in the state of thermodynamic equilibrium (Einstein 1906), an analysis of the fluctuations gives the value of the conductivity. Results are compared with those of Drude, Lorentz and Sommerfeld, the latter being based on a solution of the Boltzmann equation of transport. Brief reference is made to the possible inadequacy of the conventional model of a conductor for a fluctuation theory. A.

537.311.31 : 538.632

8598. TEMPERATURE DEPENDENCE OF THE HALL COEFFICIENTS IN SOME SILVER PALLADIUM ALLOYS. F.E.Allison and E.M.Pugh.
Phys. Rev., Vol. 107, No. 1, 103-5 (July 1, 1957).

The Hall coefficient for Ag–Pd alloys containing 80% and 60% Pd has been measured as a function of temperature from 4°K to 300°K. These alloys are of great interest because their electronic structure is similar to that of the Cu–Ni alloys, which have been investigated recently. The Hall coefficient has been found to be strongly temperature-dependent in the Ag–Pd alloys; however, the form of the temperature dependence is different from that observed in the ferromagnetic Cu–Ni alloys and is well represented by an empirical equation of the form $R_0^* = A + C/(T - \theta)$. Since the extraordinary Hall effect causes Cu–Ni alloys to exhibit a similar behaviour when measured above their Curie temperatures, the temperature dependence in these Pd–Ag alloys is ascribed to an extraordinary Hall effect. A.

537.311.31 : 538.63

8599. RESISTANCE AND MAGNETO-RESISTANCE OF DILUTE ALLOYS OF COPPER AND GOLD WITH NICKEL AT LOW TEMPERATURES. G.J.Los and A.N.Gerritsen.
Physica, Vol. 23, No. 7, 633-40 (July, 1957).

Besides an observable minimum, the resistance temperature relation does not show any irregularity down to 1.2°K. Deviations from the Kohler diagram and a decrease of the resistance in a magnetic field for the higher nickel concentrations in copper (2.2 at. %) indicate the existence of anomalies of the same character as found for the alloys with chromium and manganese. The effects are too small, however, to allow for an application of the suggestions made by Korringa and Gerritsen for the case of the alloys with manganese. A.

537.311.31 : 536.212.2

ELECTRICAL CONDUCTIVITY OF RHODIUM, IRIDIUM AND PLATINUM. See Abstr. 8141

537.311.31 : 539.234

CHANGES IN ELECTRICAL RESISTANCE OF EVAPORATED SILVER FILMS. See Abstr. 8218

537.311.31 : 536.48 : 536.212.2

ELECTRICAL CONDUCTIVITY OF CHROMIUM AT LOW TEMPERATURES. See Abstr. 8550

537.311.31 : 536.212.2

ELECTRICAL CONDUCTIVITY OF TUNGSTEN SINGLE CRYSTALS. See Abstr. 8551-2

537.311.32

8600. THE ELECTRICAL CONDUCTION OF GLASS AT HIGH FIELD STRENGTHS. J.Vermeer.
Physica, Vol. 22, No. 12, 1257-68 (Dec., 1956).

The direct current ionic conductivity at very high field strengths of four kinds of glass has been measured. It appeared that above about 100 kV/cm the final conductivity increased exponentially with the field strength. The dependence on temperature could be described by the normal exponential Rasch and Hinrichsen law. Values of the activation energies and the average jump distances of the movable ions could be deduced. A.

537.311.33

8601. SEMICONDUCTOR SURFACE PHYSICS.
Edited by R.H.Kingston with the assistance of E.Burstein, A.L.McWhorter, P.H.Miller, Jr, D.T.Stevenson and P.B.Weisz.
Philadelphia: University of Pennsylvania Press (1957) xvi + 413 pp.

For abstracts of some of the papers presented at this Conference see Abstr. 7861-80 (1957).

537.311.33

8602. REPORT OF THE MEETING ON SEMICONDUCTORS.
Publication of the Physical Society (1957) 153 pp.

For abstracts see Abstr. 7881-903 (1957).

537.311.33 : 539.217

8603. AN ANALYSIS OF DIFFUSION IN SEMICONDUCTORS. S.Zaromb.
I.B.M. J. Res. Developm., Vol. 1, No. 1, 57-61 (Jan., 1957).

In the experimental determinations of the coefficients of diffusion of impurities in semiconductors reported to date, it has usually been assumed that these coefficients do not vary with concentration. This assumption is questioned here. Interactions between acceptors, donors, electrons, and holes may lead to complicated diffusion equations, as shown by an analysis based on Onsager's theory. In particular, appreciable covalent compound formation is likely to occur between some substitutional donors and acceptors. This alone may lead to a marked dependence of diffusion coefficients on concentration, and to diffusion of acceptors induced by concentration gradients of donors and vice versa. Such effects are suggested by some discrepancies in the experimental results reported thus far. A.

537.311.33

8604. METHOD OF CALCULATING THE ENERGY LEVELS OF DEEP TRAPS IN A SEMICONDUCTING CRYSTAL. J.des Cloizeaux and P.André.
J. Phys. Radium, Vol. 18, No. 7, 441-6 (July, 1957). In French.

For a calculation of the energy levels of deep lying traps in semiconductors, the effective mass approximation is not possible. However, if the effective masses for the valence and conduction bands and also the gap between these bands are known, it is possible to estimate the energy spectrum in these bands (method of interband connection). These results can be used for the calculation of the energy levels of deep lying traps. The method is discussed and tested for a one dimension model. A.

537.311.33

8605. ON THE ELECTRICAL PROPERTIES OF DEGENERATE SEMICONDUCTORS. E.Haga.
J. Phys. Soc. Japan, Vol. 12, No. 2, 217 (Feb., 1957).

The dependence of resistance and mobility ratios on the degree of degeneracy are given for the case of non-polar semiconductors in which lattice vibrations and ionized impurities are predominant as the scattering sources. J.Franks

537.311.33

8606. AN EMPIRICAL REGULARITY OF ENERGY GAP IN SEMICONDUCTORS. T.Miyauchi.
J. Phys. Soc. Japan, Vol. 12, No. 3, 308 (March, 1957).

The ratio of half atom spacing to average radius of the positive ions is plotted against band gap for various semiconductors. Reasonably straight lines are obtained for each group, increasing in slope from group IV elements through the $A^{III}B^{V}$ group to the $A^{II}B^{VI}$ group with increasing ionic character of bonding. No reason for the linear relation is given. Silicon and Mg_2Si deviate from the scheme. D.Haneman

537.311.33 : 538.632

8607. RESISTIVITY AND HALL COEFFICIENT OF SEMICONDUCTORS. K.Shogenji and S.Uchiyama.
J. Phys. Soc. Japan, Vol. 12, No. 4, 434 (April, 1957).

Theoretical formulae for these are derived for the case where the current carriers are scattered by optical as well as acoustical modes of lattice vibration, other scattering sources being neglected. D.Haneman

537.311.33

8608. OBSERVATION OF THE ACOUSTOELECTRIC EFFECT. G.Weinreich and H.G.White.
Phys. Rev., Vol. 106, No. 5, 1104-6 (June 1, 1957).

Preliminary observations were made on n-type germanium in the temperature range 78-110°K with transverse acoustic waves (20-60 Mc/s) travelling in the ⟨100⟩ direction and polarized in the ⟨010⟩ direction. The intervalley relaxation time was deduced from the measured electric fields and found to be proportional to $\exp\theta/T$ (T = absolute temperature, $\theta = 250°K$) with an absolute value of 1.3×10^{-10} sec at 78°K. R.Stratton

537.311.33

8609. STATISTICS OF THE CHARGE DISTRIBUTION FOR A LOCALIZED FLAW IN A SEMICONDUCTOR. W.Shockley and J.T.Last.
Phys. Rev., Vol. 107, No. 2, 392-6 (July 15, 1957).

A localized flaw such as a vacancy-interstitial pair, gold atom, or small void is considered. It is found that the charge situation can be described by a set of energy levels which are independent of the Fermi level but which are temperature-dependent. If the flaw is electrically neutral for a certain position of the Fermi level, then as the Fermi level is raised from the neutral level successively above each higher-lying level of the set, the flaw acquires an additional electron unit of negative charge. These levels are called the first-acceptor level, second-acceptor level, etc. The energy levels are essentially equal to $kT\ln(Z_1/Z_2)$, where Z_1 and Z_2 are the contributions of the flaw to the state sum for the system for the two conditions of charge. Similarly, as the Fermi level is lowered below the neutral point, it passes the first-donor level, second-donor level, etc., and the flaw acquires charges of plus one, plus two, etc. The statistics are derived for the distribution for the various conditions of charge, referred to as first-donor condition, neutral condition, first-acceptor condition, etc. A.

537.311.33

8610. VASILEFF'S CALCULATION OF ELECTRONIC SELF-ENERGY IN SEMICONDUCTORS. E.N.Adams.
Phys. Rev., Vol. 107, No. 3, 671 (Aug. 1, 1957).

It is shown that Vasileff's theory (Abstr. 3275/1957) expressing the shift of the thermal band edge in terms of such parameters as effective mass fails for semiconductors of the usual type because of the predominance of processes involving virtual phonons of large wave-number. A.

537.311.33 : 537.311.62 : 535.34

8611. THE ANOMALOUS SKIN EFFECT AND THE OPTICAL ABSORPTIVITY OF SEMICONDUCTORS. II. R.B.Dingle.
Physica, Vol. 22, No. 12, 1237-41 (Dec., 1956).

In Pt I (Abstr. 8183/1956) tentative expressions for optical absorption by semiconductors were obtained by averaging expressions valid for metals over the "transport distribution function", and the results discussed. In the present work, more general formulae are derived rigorously by solving the integro-differential equation of the anomalous skin effect. A.

537.311.33

8612. ON THE EQUIVALENCE OF THE FOKKER–PLANCK METHOD AND THE FREE-ENERGY METHOD FOR THE CALCULATION OF CARRIER DENSITY FLUCTUATIONS IN SEMICONDUCTORS. K.M.van Vliet.
Physica, Vol. 23, No. 3, 248-52 (March, 1957).

The Fokker–Planck method for the calculation of carrier density fluctuations in semiconductors is applied to a semiconductor with transitions between the valence band, the conduction band, and one kind of impurity levels. It is shown that the results are quite consistent with Burgess' equations, obtained by the thermodynamic free-energy method. A.

537.311.33 : 621.314.7 : 621.314.63 : 621.315.59

8613. THE EFFECT OF NUCLEAR RADIATION ON SELECTED SEMICONDUCTOR DEVICES. G.L.Keister and H.V.Stewart.
Proc. Inst. Radio Engrs, Vol. 45, No. 7, 931-7 (July, 1957).

Selected samples of both germanium and silicon devices have been exposed to a nuclear radiation environment. This environment consisted of either a fission-produced gamma spectrum or a combined neutron and gamma spectrum as obtained in the graphite region of a materials testing reactor. Several parameters of the devices were measured before, during, and after irradiation. Noise and photovoltaic voltages were observed during exposure to a gamma flux of 2×10^6 r/hr. In some devices, transient changes occurred in those parameters sensitive to surface conditions. After continued exposure of from 5×10^5 to 5×10^8 r or 5×10^{10} to 5×10^{13} neutrons per cm^2, permanent damage occurred in the device characteristics. No real distinction could be made between silicon or germanium devices so far as noise, photovoltaic, or transient effects are concerned. However, there is a marked difference between silicon and germanium devices with respect to permanent damage. Silicon devices are more susceptible to damage in parameters dependent upon the minority carrier lifetime such as the current gain, the forward resistance of high efficiency diodes, and the valley voltage of unijunction transistors. Germanium devices are also susceptible to the conversion of n-material to p-type and this results in the reduction of the punch-through voltage of p–n–p germanium transistors. For both silicon and germanium transistors it was found that the thinner base transistors were the more resistant to reduction in current gain. A.

537.311.33 : 621.315.59

8614. RELATION BETWEEN RATIO OF DIFFUSION LENGTHS OF MINORITY CARRIERS AND RATIO OF CONDUCTIVITIES. S.S.L.Chang.
Proc. Inst. Radio Engrs, Vol. 45, No. 7, 1019-20 (July, 1957).

Shows that if the minority carrier lifetimes are inversely proportional to the majority carrier densities, the relation $(L_p/L_n)^2 = (\sigma_p/\sigma_n)$ obtains, where the symbols have their usual meanings. F.F.Roberts

537.311.33 : 537.323

8615. ELECTRICAL PROPERTIES OF THE INTERMETALLIC COMPOUND CdSb. I.M.Pilat.
Zh. tekh. Fiz., Vol. 27, No. 1, 119-22 (1957). In Russian.

From Cd and Sb containing 10^{-4}% impurity single crystals of CdSb were prepared with various departures from stoichiometric composition and containing various quantities of Al, Te, Pb or Sn. The electrical conductivity (σ) was measured in the temperature range 90-520°K; at 520°K an irreversible change occurred. For specimens with composition differing by 0-0.6% from stoichiometric the activation energy was 0.43-0.52 eV; intrinsic conductivity began at 60-70°C. Low temperature measurements showed up activation energies of 0.0135, 0.0296 and 0.0695 eV. At room temperature σ = 0.5-1.0 $ohm^{-1}\ cm^{-1}$. Large departures from stoichiometry gave a region with positive temperature coefficient of resistance. For specimens close to stoichiometric the thermal e.m.f. (α) against Cu reached 350 V/°C. α fell rapidly with increasing departure from stoichiometry. Of the dopes listed above, the most interesting was Pb, which in concentration of 0.009% changed the conductivity to n-type with activation energy 0.065 (290-380°K) and 0.40 eV (380-500°K). Diode and triode properties of CdSb crystals with the various dopes were also investigated. A.F.Brown

537.311.33

8616. ELECTRICAL PROPERTIES OF CERTAIN COMPOUND OXIDE SEMICONDUCTORS.
B.T.Kolomiets, I.T.Sheftel' and E.V.Kurlina.
Zh. tekh. Fiz., Vol. 27, No. 1, 51-72 (1957). In Russian.

Describes the preparation and the composition of specimens of

the type CuO–MnO–O and CoO–MnO–O. The resistivity is examined as a function of the composition. The different compositions are examined by X-rays to determine the lattice structure and optically to reveal the grain structure. Although the processes taking place in such materials are shown to be very complex, the influence of separate factors on the electrical parameters may be distinct. In this way it is possible to control the resistivity. W.Bardsley

537.311.33

8617. OBSERVATION OF THE DRIFT OF GERMANIUM SURFACE BY FIELD EFFECT EXPERIMENT. M.Kikuchi.
J. Phys. Soc. Japan, Vol. 12, No. 4, 436 (April, 1957).

Conductance and photoconductance for a 25 ohm cm n-type specimen were measured in air at various times after etching, revealing a drift in barrier height over a period of days of about 0.1 volt. D.Haneman

537.311.33 : 537.322.1

8618. SOME ASPECTS OF PELTIER HEATING AT LIQUID–SOLID INTERFACES IN GERMANIUM.
W.G.Pfann, K.E.Benson and J.H.Wernick.
J. Electronics, Vol. 2, No. 6, 597-608 (May, 1957).

Peltier heating at a liquid–solid interface has unique advantages in controlling crystal growth processes in semiconductors and certain metals. The heat effect is produced at the interface without time-lag and can be reversed by reversing the current. Uses of Peltier heating in growing single crystals, in producing n–p–n and n–p–n–p junctions in semiconductors, and in temperature gradient zone melting are discussed. The velocity of interface movement due to Peltier heating permits an estimate of the Peltier coefficient P of a substance against its own liquid; approximate values of 0.013 V for Bi and ~0.2 V for Ge were obtained. The direction of movement of a small molten alloyed region in a rod of solid Ge when a current is passed determins the sign of the Peltier coefficient for solid Ge against the particular alloy. Such determinations on essentially intrinsic Ge, show P to be negative for alloys with Pt, Pd, Au, Ni, and positive for alloys with Ag, Al, Bi, Cu, Ga, Sn, Mg, Pb, Sb, and Te, where positive P signifies absorption of heat when current flows from solid to liquid. The influence of Joule heating which accompanies Peltier heating is assessed and means for avoiding its effect are discussed. A.

537.311.33

8619. ON THE ATOMIC DISPLACEMENTS PRODUCED BY α-PARTICLES IN GERMANIUM.
A.Ascoli, M.Asdente and E.Germagnoli.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1145-52 (May, 1957).

The number of negative carriers which are removed from the conduction band by irradiation of germanium single crystals with Po^{210} α-particles is measured from the initial rate of decrease of conductivity in n-type germanium. It has been found that (79 ± 5) electrons are removed by a 5.30 MeV α-particle. The possibility of comparing this result with the theory of atomic displacements by high energy charged particles is discussed. A.

537.311.33 : 538.63

8620. GALVANOMAGNETIC EFFECTS IN GERMANIUM.
G.C.Della Pergola and D.Sette.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1670-8 (June, 1957).
In Italian.

Resistivity and Hall effect measurements were performed at room temperature on n-type and p-type oriented germanium single crystals, as a function of intensity of magnetic induction, between 0.15 and 1.0 Wb/m^2. The results of the measurements are compared with theoretical expectations based on the present knowledge of germanium band structure. The comparison is satisfactory for n-type germanium; the ratio of longitudinal to transverse electron effective masses has been found to be between 8 and 12. The valence band structure of germanium is so complicated that no mathematical treatment has been developed to compare the results of measurements of galvanomagnetic effects in p-type germanium with theory. An approximate theory has been however used to partially explain the experiment; the observed anisotropy however can not be explained in this way. A.

537.311.33

8621. RECOMBINATION IN PLASTICALLY DEFORMED GERMANIUM. G.K.Wertheim and G.L.Pearson.
Phys. Rev., Vol. 107, No. 3, 694-8 (Aug. 1, 1957).

Lifetimes in plastically deformed n- and p-type germanium have been measured as a function of the amount of deformation and as a function of temperature. The results indicate that the dislocations have an electron capture radius of 3.4×10^{-8} cm. The lifetime in high-purity crystals containing 10^3 to 10^4 dislocations per cm^2 may consequently be limited by recombination at dislocations. A.

537.311.33

8622. PHASE TRANSITION OF In_2Se_3.
H.Miyazawa and S.Sugaike.
J. Phys. Soc. Japan, Vol. 12, No. 3, 312 (March, 1957).

Large single crystals were grown, and their electrical conductivity, Hall constant, thermoelectric power and thermal expansion measured as a function of temperature. All these properties changed abruptly at 200°C, indicating a phase transition of the first order. B.T.M.Willis

537.311.33

8623. ANOMALIES OF ELECTRICAL PROPERTIES OF LEAD TELLURIDE CRYSTAL. S.Uchiyama and K.Shogenji.
J. Phys. Soc. Japan, Vol. 12, No. 4, 431 (April, 1957).

A sign reversal of the Hall effect of a PbTe crystal was found in the extrinsic temperature range after the crystal had been doped by evaporating copper and heating at 500°K. Various other anomalies such as a non-linear current–voltage characteristic and a magnetoresistive effect proportional to the field rather than to the square of the field are attributed to an inhomogeneous density of current carriers. K.W.Plessner

537.311.33

8624. ANOMALOUS ELECTRICAL PROPERTIES OF LEAD TELLURIDE. Y.Kanai and R.Nii.
J. Phys. Soc. Japan, Vol. 12, No. 4, 441 (April, 1957).

These include reversal in sign of Hall coefficient at low temperature for some p-type specimens. In the low temperature n-type region the magnetoresistance and Hall coefficient showed anomalous variation with magnetic field. D.Haneman

537.311.33 : 548.57

8625. SOME OBSERVATIONS OF THE EFFECTS OF OXYGEN ON THE MINORITY CARRIER LIFETIME AND OPTICAL ABSORPTION OF SILICON CRYSTALS PULLED IN VACUO.
G.W.Green, C.A.Hogarth and F.A.Johnson.
J. Electronics and Control, Vol. 3, No. 2, 171-82 (Aug., 1957).

The techniques and the equipment used for producing single crystals of silicon by pulling from a melt in vacuo are described and some electrical characteristics of crystals so grown are reported. The minority carrier lifetime decreases radially from the centre of the crystals and this behaviour is believed to arise from a difference in oxygen concentration, being greater near the axes of the crystals and smaller towards the edges. Optical absorption measurements, which indicate the relative concentrations of oxygen in silicon crystals grown by various techniques, suggest that while there is a low concentration in vacuum-grown crystals, there is still a radial variation as postulated above. The oxygen is believed to reside at dislocations where it is held as SiO_2 and thus relieves the local strain fields. A.

537.311.33 : 537.226.2

INVESTIGATION OF THE DIELECTRIC CONSTANT OF SEMICONDUCTORS. See Abstr. 8587

537.311.33

8626. GENERAL SEMICONDUCTOR JUNCTION RELATIONS.
N.H.Fletcher.
J. Electronics, Vol. 2, No. 6, 609-10 (May, 1957).

General carrier density relations are derived for the case of an abrupt junction between two sections of semiconductor with arbitrary impurity contents and with an arbitrary applied bias. These relations reduce to those of Shockley at very low bias levels, but in addition take account of all types of conductivity modulation effects. A.

537.311.33

8627. MULTIPLICATION OF CHARGE CARRIERS AND BREAKDOWN IN Ge P–N JUNCTION. I. C.Yamanaka and T.Suita.
J. Phys. Soc. Japan, Vol. 12, No. 3, 310 (March, 1957).

The relation between current multiplication and breakdown voltage was studied at 26°C and −170°C. At 26°C there was a decrease of current with time at 70% of the breakdown voltage, but the current drift disappeared at 90%. Voltage–current curves indicated that the current multiplication and breakdown voltage were temperature dependent. The distribution of current pulses was measured at −170°C for current densities from 0.4 to 6.2 mA. B.T.M.Willis

537.311.33

8628. NOISE FROM Ge PN JUNCTION AND γ-RAY IRRADIATION EFFECT. Y.Inuishi.
J. Phys. Soc. Japan, Vol. 12, No. 4, 439 (April, 1957).

A p–n junction diode became less efficient after 10^6 roentgen dose of γ-rays and exhibited increased noise. D.Haneman

537.311.33

8629. A QUANTITATIVE THEORY OF THE ELECTRO-FORMATION OF METAL–GERMANIUM POINT CONTACTS. A.C.Sim.
J. Electronics and Control, Vol. 3, No. 2, 139-59 (Aug., 1957).

It is shown conclusively that a high source impedance is necessary for the attainment of highly reproducible results, and that a uni-directional pulse having a particular minimum duration is optimum. Further control on the results of forming is achieved by adjustment of the transient conditions. A quantitative calculation of the three-dimensional temperature distribution during forming is given without preposterous assumptions. A detailed computation of the thermal acceptor–density distribution is also provided from which, together with estimates of other effects, an intimate quantitative picture of the resultant structure under the point can be derived. The calculated quantities agree within about 40% with practice, and more accurate calculations could be made by extension and elaboration of the theory, but this is not considered to be justifiable. One interesting outcome is that the diameter of contact must not exceed $\pi \times 10^{-4}$ in. per ampere of forming current if good and controlled characteristics are desired. A.

537.311.33

8630. MEASUREMENTS OF THE CURRENT IN N–P GERMANIUM JUNCTIONS AS A FUNCTION OF THE TEMPERATURE. M.Bernard.
J. Electronics, Vol. 2, No. 6, 579-96 (May, 1957). In French.

The inverse current I_o, of several n–p germanium junctions obtained by drawing is studied between -50°C and 100°C; the curves of log I_o against 1/T show that for temperatures higher than about 10°C the inverse current is in good agreement with (a) the formula given by Shockley

$$I_o = qD_p\left(\frac{p_n}{L_p}\right) + qD_n\left(\frac{n_p}{L_n}\right)$$

(b) the Shockley–Read theory of the mechanism of recombination. On the other hand, for temperatures lower than 10°C the inverse current arises from the generation of electron–hole pairs in the space charge layer. Below -50°C the inverse current becomes less than 10^{-10} A; from -50°C to the temperature of liquid nitrogen the forward current at constant voltage is measured; the set of curves of log I_d against 1/T can be interpreted on the Shockley–Read theory by supposing that the current–voltage characteristic of the junction is $I_d = I_o[\exp(qv/\alpha kT) - 1]$ where α varies from 1 to 2. In a calculation given in the appendix it is shown that this results directly from the hypothesis that, even in forward bias, the generation and recombination in the space charge layer are the main process. The measurements allow several determinations of the position of the centres of recombination in the forbidden band to be obtained; in the case of a junction containing a trace of copper a level is found at 0.23 eV below the valency band. A.

537.311.33

8631. ON THE PROBLEM OF THE STRUCTURE OF THE UPPER, ADJACENT TO THE ELECTRODE, LAYER OF A SELENIUM RECTIFIER. V.A.Dorin and D.N.Nasledov.
Zh. tekh. Fiz., Vol. 27, No. 1, 90-4 (1957). In Russian.

The structures at diffusion interfaces of Sn–S and Sn–Se were studied by electron diffraction. Typical electron diffraction pictures are reproduced and the complete results given in tables showing the variation of observed structure with experimental conditions at the interfaces. The probable structure of the blocking layer in a Se rectifier with an upper electrode composed of Cd–Sn alloy is discussed. A.F.Brown

537.312.5

8632. ON THE INTERNAL RESISTANCES AND CAPACITY OF SELENIUM PHOTOCELLS AT LOW TEMPERATURES. G.Blet.
J. Phys. Radium, Vol. 18, No. 5, 297-303 (May, 1957). In French.

Direct and inverse conductances of a selenium photocell have been investigated as functions of the applied potential difference (between 0.001 and 5 volts) and of the temperature (between 66°K and 300°K). The variations are considerable, extending over a range of $1 : 10^5$. Comparison between experimental values and the theoretical laws of potential barrier height yields the somewhat low value of 0.5 V. The check is qualitative and becomes quantitative only when the applied voltage is very low, and at practically room temperature. A forthcoming paper will deal with the capacity. A.

537.312.5

8633. COOLED PHOTOCONDUCTIVE DETECTORS USING INDIUM ANTIMONIDE. D.W.Goodwin.
J. sci. Instrum., Vol. 34, No. 9, 367-8 (Sept., 1957).

Improvement in the sensitivity of InSb photoconductive cells which operate at room temperature can be achieved under certain conditions by cooling cells to temperatures below ambient. Details of the performance of such cooled cells are given. A.

537.312.5

8634. THERMAL AND ELECTROLYTIC ACTIVATION OF PHOTOCONDUCTIVITY IN CdS CRYSTALS. J.Woods.
J. Electronics and Control, Vol. 3, No. 2, 225-35 (Aug., 1957).

The photoconductivity and dark conductivity of cadmium sulphide crystals grown by the Frerichs technique can be increased by heat treatment in vacuum or in air. Free cadmium is present on the surface and at internal cracks of a crystal as grown. Heating at $100\text{-}300^\circ$C in the presence of the free cadmium leads to a non-stoichiometric excess of cadmium in the lattice, and considerable activation is achieved. At temperatures in excess of 300°C thermal dissociation occurs, sulphur is lost and a further non-stoichiometric excess of cadmium is formed. The application of an electric field assists dissociation by electrolytic processes. The activation of cadmium sulphide crystals resulting from dielectric breakdown previously reported by the author (1956) can now be understood. Heat treatment in vacuum produces a high surface conductivity accompanied by a high photosensitivity to blue light. Both are reduced by exposure to oxygen at room temperature. Heat treatment in air produces electron trapping levels which are not created by corresponding treatment in vacuum. A.

537.312.5

8635. PHOTOELECTRIC EMISSION FROM BARIUM OXIDE. H.R.Philipp.
Phys. Rev., Vol. 107, No. 3, 687-93 (Aug. 1, 1957).

Photoelectric emission measurements were made on sprayed coatings of BaO in several states of thermionic activity and at different temperatures. The yield from active cathodes shows a rise at a quantum energy of 3.8 eV ascribed to exciton-induced emission and another rise at 5 eV attributed to electrons ejected from the filled band. A magnetic velocity analyser was used to determine the energy distribution of emitted electrons. The data indicate that the emission at low quantum energies arises primarily from direct ionization of impurity levels located photoelectrically about 2 eV below the vacuum level. For higher incident quantum energies, where exciton-induced emission is expected, a new energy distribution appears which peaks at very low energy. This peak does not shift with increasing $h\nu$ and is similar to the slow-group distribution observed in the alkali halides. A.

537.312.62

8636. THE VOLUME CHANGE AT THE SUPERCONDUCTING TRANSITION. J.L.Olsen and H.Rohrer.
Helv. phys. Acta, Vol. 30, No. 1, 49-66 (1957).

The changes in length of polycrystalline rods of tin, lead, indium, thallium and tantalum on destruction of superconductivity by a magnetic field have been measured. The change in critical magnetic field H_C with pressure p derived from these observations may be described within the limits of experimental error by $\partial H_C/\partial p = a + b(T/T_C)^2$ with the following values for a and b in units of 10^{-6} Oe dyn^{-1}cm^2: Pb : a = −6.3, b = −4.8; In : a = −3.4, b = −2.4; Ta : a = +7, b = −11. In the case of thallium $a \simeq 0$, and b is highly anisotropic with a value for polycrystalline material consistent with Hattons value of +1.6. For tin $a/(a + b) = 0.58$. A.

537.312.62

8637. QUASICHEMICAL EQUILIBRIUM APPROACH TO SUPERCONDUCTIVITY. M.R.Schafroth, S.T.Butler and J.M.Blatt.
Helv. phys. Acta, Vol. 30, No. 2-3, 93-134 (1957).

A new approximation method for the partition function of a system of interacting Fermi particles is proposed. It consists in neglecting all dynamical correlations between more than pairs of particles, including however all statistical correlations. It is shown that this approximation is valid in the following two cases: (i) In a dilute gas of atoms capable of forming diatomic molecules one gets the thermodynamical theory of chemical equilibrium; (ii) For the electron gas in metals one gets an extension of the free-electron theory which takes into account the interactions to a first approximation. The validity of the approximation in this case is dependent on the quenching effect of the Pauli principle which forbids most

scattering processes between electrons. The quenching of the dynamical correlation by the Pauli principle follows automatically from the theory. In both cases (i) and (ii) one finds that the thermodynamical properties of the system are given in the form of a chemical equilibrium between the fermions ("atoms") and diatomic "(pseudo-)molecules", the latter obeying Bose statistics. They can, under certain conditions, undergo a Bose–Einstein condensation and, in case (ii) thereby produce a transition to a superconducting state. This depends on the properties of the correlation and is not followed in detail here. It is, however, shown qualitatively that the interaction of electrons through the phonon field should have the features required for such a transition. A.

537.312.62

8638. A NOTE ON THE ENERGY GAP MODEL OF SUPERCONDUCTIVITY. M.J.Buckingham.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1763-5 (June, 1957).

Bardeen (Abstr. 7066/1955) has shown that a Meissner effect will exist if the energy spectrum of a superconductor contains a gap, if it is assumed that the matrix elements for optical transitions are unchanged by the presence of the gap. It is now shown by means of a general theorem that this assumption cannot be valid. R.G.Chambers

537.312.62

8639. GAUGE INVARIANCE AND THE ENERGY GAP MODEL OF SUPERCONDUCTIVITY. J.Bardeen.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1766-8 (June, 1957).

A reply to Buckingham (preceding abstract); it is claimed that Bardeen's result remains true if the gauge is chosen to give div A = 0. The effect of collective modes in the electron system is briefly discussed. R.G.Chambers

537.312.62

8640. ON THE POSSIBILITY OF A DYNAMIC VARIETY OF THE INTERMEDIATE SUPERCONDUCTIVE STATE. C.J.Gorter.
Physica, Vol. 23, No. 1, 45-56 (Jan., 1957).

It is suggested that, in contradiction to F.London's supposition, the boundaries between the normal and the superconductive regions in the intermediate state would tend to orientate themselves not perpendicular to an electric current but parallel to it. Then these boundaries would move in the direction perpendicular to the current and to the local magnetic field and the voltage drop observed in the direction of the current would be due to induction. This picture gives a natural description of the behaviour of a wire in a large transversal field, of a wire carrying a large current and of the quasi paramagnetism observed for a current-carrying wire in a longitudinal field. A.

537.312.62 : 536.48

SUPERFLUIDITY AND SUPERCONDUCTIVITY. See Abstr. 8569

537.312.62 : 530.145

INTERACTION BETWEEN WAVES AND ELECTRONS, WITH SOME REMARKS ON SUPERCONDUCTIVITY. See Abstr. 8425

537.312.62 : 536.48

QUANTUM FLUID AS A COMMON MODEL FOR SUPERFLUIDITY AND SUPERCONDUCTIVITY. See Abstr. 8565

537.323

8641. THERMOELECTRIC AND THERMAL PROPERTIES OF SEMICONDUCTORS. A.Joffe.
J. Phys. Radium, Vol. 18, No. 4, 209-13 (April, 1957). In French.

Theory shows that the efficiency of a thermocouple depends on the ratio σ/κ between electrical (σ) and thermal (κ) conductivity of the components, and allows the estimation of the effect of impurities. It follows that semiconductors are to be preferred to metals for the construction of thermopiles, and, conversely, heating and cooling elements. Experimental results obtained on lead telluride and sulphide, on bismuth and antimony telluride, with or without addition of selenium, corroborate these views. The thermocouples constructed allow already some interesting applications and could provide one of the best means for the direct utilization of solar energy. A.

537.323 : 537.311.33

8642. AN INVESTIGATION OF THE THERMOELECTRIC PROPERTIES OF LEAD TELLURIDE AND LEAD SELENIDE. N.V.Kolomoets, T.S.Stavitskaya and L.S.Stil'bans.
Zh. tekh. Fiz., Vol. 27, No. 1, 73-81 (1957). In Russian.

Measurements were made of the temperature variation (100-700° K) of the thermal e.m.f., electrical conductivity and carrier concentration for the whole range (0-100%) of solid solutions of the system PbTe–PbSe. From the measurements, temperature and composition variation of the carrier mobility and the effective cross-section (S) of scattering centres were derived. Complete results are given graphically. S never exceeded 2×10^{-16} cm^2. Variation of S with velocity of charge carriers was according to a law of the form $S \sim \lambda^{-4}$ (λ = de Broglie wavelength), the same formula as for Rayleigh scattering of light. A.F.Brown

ELECTRIC DISCHARGES 537.52

537.523.3

8643. REMARKS ON V.I.POPKOV'S PAPER "ON THE THEORY OF CORONA DISCHARGE IN A GAS AT CONSTANT VOLTAGE". L.É.Tsȳrlin.
Zh. tekh. Fiz., Vol. 25, No. 13, 2403-5 (1955). In Russian.

The author criticizes Popkov's paper (Izv. Akad. Nauk SSSR, Otd. tekh. Nauk, No. 5, 1953) and suggests that Popkov applied an incorrect form of solution to a correct equation system. F.Lachman

537.523.3

8644. ON THE PROBLEMS OF THE THEORY OF THE BIPOLAR DIRECT-CURRENT CORONA. V.I.Popkov.
Zh. tekh. Fiz., Vol. 25, No. 13, 2406-10 (1955). In Russian.

A detailed criticism of Tsȳrlin's paper (Zh. tekh. Fiz., Vol. 23, No. 10, 1954) containing the solution of the problem of the volt–ampere characteristic of the bipolar corona. The author questions in particular Tsȳrlin's fundamental assumptions, his idea of the physical mechanism of the corona, and his treatment of the author's previous papers (Izv. Akad. Nauk SSSR, Otd. tekh. Nauk, No. 4, 1948; Abstr. 1037/1949). F.Lachman

537.523.3

8645. A WRONG HYPOTHESIS IN THE THEORY OF THE [DISCHARGE] CORONA. G.N.Aleksandrov and N.N.Tikhodeev.
Zh. tekh. Fiz., Vol. 27, No. 2, 410-13 (1957). In Russian.

Points out that Popkov's discussion article (see preceding abstract) deals in great detail with the problem of the so-called critical gradient of the corona potential, and the argument used, although widely accepted in both physical and electrical-engineering literature, is considered by the authors to be erroneous. The errors are attributed to an unfounded hypothesis of Pik (Dielectric phenomena in high-voltage engineering, in Russian, 1934), viz. that the corona discharge is generated and maintained (for every voltage semi-wave) at different gradients, and to a previous paper of Popkov (Abstr. 1037/1949). F.Lachman

537.523.3

8646. ON THE CRITICAL GRADIENTS OF THE CORONA. V.I.Popkov.
Zh. tekh. Fiz., Vol. 27, No. 2, 413-17 (1957). In Russian.

The author replies to Aleksandrov and Tikhodeev's criticism (see preceding abstract) and deals with, one by one, their arguments. F.Lachman

537.523.3

8647. REMARKS ON V.I.POPKOV'S PAPER "ON THE PROBLEMS OF THE THEORY OF THE BIPOLAR DIRECT-CURRENT CORONA". L.É.Tsȳrlin.
Zh. tekh. Fiz., Vol. 27, No. 2, 417-21 (1957). In Russian.

The author discusses Popkov's work (see four preceding abstracts), in particular its part where Popkov rejects the allegation of wrongly developed equations, contained in the author's previous paper (Zh. tekh. Fiz., Vol. 23, 1788, 1953). The author maintains his arguments. F.Lachman

537.525

8648. PRODUCTION OF A CONTINUOUS CURRENT BY A HIGH-FREQUENCY DISCHARGE. II. M.Chenot.
J. Phys. Radium, Vol. 18, No. 6, 395-402 (June, 1957). In French.

For Pt I, see Abstr. 5359 (1957). Experiments made at a frequency of 22 Mc/s have confirmed and developed previously obtained results at a frequency of 7.69 Mc/s. A general study of the influence of the frequency of excitation has been made at frequencies 3.59 Mc/s to 44.7 Mc/s; it was possible to follow the evolution of the phenomenon up to pressures and frequencies giving the easiest discharge conduction through the tube. A coordination of experimental results is proposed based on the curves of breakdown potential and least maintenance potential of the discharge for the different parts of the tube whose boundaries are fixed by successive electrodes. A.

537.525.8

8649. AMBIPOLAR DIFFUSION IN A MAGNETIC FIELD IN THE CASE OF GLOW DISCHARGE. S.N.Goswami.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1769-70 (June, 1957).

A brief theoretical discussion, in which the usual equations describing ambipolar diffusion in the absence of a magnetic field are modified to allow for the latter, when perpendicular to the direction of the electric field. Reference is made to work of Simon (Abstr. 5431/1955) with which the present results conform. J.D.Craggs

537.527.4 : 534.222.2

8650. EFFECTS OF SHOCK WAVE UPON GASEOUS DISCHARGE. S.Nagao.
J. Phys. Soc. Japan, Vol. 12, No. 2, 216 (Feb., 1957).

Briefly describes, with an experimental arrangement, a system for studying the lowering of dielectric strength of a discharge gap due to passage of a shock wave. J.D.Craggs

537.529 : 537.226.1

8651. THE HIGH TEMPERATURE DIELECTRIC BREAKDOWN OF ALKALI HALIDES J.J.O'Dwyer.
Proc. Phys. Soc. B, Vol. 70, Pt 8, 761-8 (Aug., 1957).

A model is proposed for the calculation of a critical field strength for an ionic crystal containing positively charged point defects which can act as electron trapping centres. It is assumed that conduction electrons gain energy from an applied field at a rate which is limited only by their collisions with lattice vibrations, and that this energy is transferred to the lattice mainly by multiphonon emission with recombination into empty trapping centres. A critical field is calculated and it is discussed under what circumstances it could be identified with the high-temperature dielectric breakdown field of alkali halides. A.

X-RAYS 537.531

537.531 : 535.33 : 545.824

8652. X-RAY EMISSION SPECTRA OF THE RARE EARTHS. J.Blandin and J.Rose.
C.R. Acad. Sci. (Paris), Vol. 244, No. 20, 2497-9 (May 13, 1957). In French.

The sample of the rare earths to be analysed, prepared in the form of a powder, is placed on the copper anticathode of a demountable X-ray tube and bombarded with electrons. The resulting X-ray emission spectrum is then analysed with a bent-crystal spectrometer. The quantity of powder required is less than a milligramme. The method is said to be more sensitive than that of arc spectroscopy. T.Mulvey

537.531 : 535.343

8653. K X-RAY ABSORPTION EDGES OF Cr, Mn, Fe, Co, Ni IONS IN COMPLEXES. F.A.Cotton and H.P.Hanson.
J. chem. Phys., Vol. 26, No. 6, 1758-9 (June, 1957).

Brief data are given on the fine structure of the K absorption edge of metal ions in complexes of metals from Cr to Ni. The nickel K absorption edges studied by Mitchell and Beeman (Abstr. 8884/1952), have been re-investigated and alternative transitions suggested to account for the fine structure. T.Mulvey

537.531 : 539.18

8654. PROPORTIONAL COUNTER MEASUREMENTS OF π-MESONIC X-RAYS. D.West and E.F.Bradley.
Phil. Mag. (Eighth Ser.), Vol. 2, 957-76 (Aug., 1957).

A xenon filled proportional counter has proved to be a very useful instrument for the study of π-mesonic X-rays from light elements. Measurements of the K_α energies from Li^6, Li^7, Be^9, B^{10} and B^{11} are described. Energy shifts due to the short range pion–nucleon forces are observed, confirming the scintillation counter measurements. The experimental values of the energy shift are fitted equally well by the theories of Deser et al. (1954) or Karplus (1956). Measurements of L_α energies are used to deduce a value for the π-meson mass equal to $272.5 \pm 0.8\ m_e$. The natural broadening of the beryllium K_α line due to the short lifetime for capture of the π-meson from the 1s state has been measured. A width $\Gamma = 1.2 \pm 0.2$ keV was observed. Intensity ratios of K_α and K_β and L_α, L_β and L_γ lines are also reported. A.

537.531 : 535.435

INFLUENCE OF MOLECULAR ORIENTATION ON X-RAY SCATTERING BY LIQUIDS. See Abstr. 8544

CATHODE RAYS. POSITIVE RAYS 537.533/.534

537.533

8655. A NON LINEAR THEORY OF PHASE OSCILLATIONS INDUCED BY RADIATION FLUCTUATIONS IN SYNCHROTRONS. A.N.Matveev.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1782-3 (June, 1957).

The previous linear theory (Abstr. 4433/1957) is extended; the conclusion is confirmed that the use of the alternating gradient principle is inevitable for electrons of a few GeV energy. J.S.Bell

537.533.35 : 539.165.08

8656. HIGH RESOLUTION BETA SPECTROMETER OF NEW TYPE. H.Wild and O.Huber.
Helv. phys. Acta, Vol. 30, No. 1, 3-32 (1957). In German.

For the double-focusing, most luminous spectrometer with the coefficients $\alpha = 1/2$, $\beta = 3/8$ in the field expansion $H(r) = H_0(1 - \alpha\rho + \beta\rho^2 - \gamma\rho^3 \ldots)$ the image equations up to third order are calculated for an extended flat source. Hence follows for the third coefficient γ the value 43/144 for optimum conditions. The calculations for electrons of different impulses showed, that with $\beta = 3/8$ and $\gamma = 5/16$ at the same time a whole range of energy can be registered on a film, similar to the semicircular spectrograph. Moreover the double focusing remains independent of the impulse. To reach a high resolution a form for the magnet has been constructed so that (1) no marginal effects arise and (2) not only the fieldstrength, but also the coefficients α and β can be stabilized. A.

537.533.35

8657. A LONGITUDINAL [AXIAL] β-SPECTROMETER WITH COMPENSATED SPHERICAL ABERRATION.
K.A.Dolmatova and V.M.Kel'man.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 6, 1244-7 (1957). In Russian.

Constructional details are given of a β-spectrometer with an axial uniform magnetic field, spherical aberration of which is corrected by a transverse magnetic field. The transverse field is produced by means of a coil, whose wires are shaped according to the calculated form of a boundary of aberration-free field. In experiments with the F-line of ThB the half-width was reduced by a factor of 2-3. J.M.Zarzycki

537.533.74

8658. EFFECTIVE ELECTRON–ELECTRON AND ELECTRON–ION CROSS-SECTIONS IN PLASMAS. M.Bayet.
J. Phys. Radium, Vol. 18, No. 6, 380-6 (June, 1957). In French.

Definitions of different effective cross-sections for elastic scattering are recalled, and it is pointed out that their values are infinite in the case of strictly Coulomb interaction (i.e., r^{-1} potential); but, in the case of actually existing electron gases, which are part of macroscopically neutral "plasmas" (because of positive ions), it is possible to find finite cross-sections, if one uses the results of Debye's theory of electrolytes, which states that the potential obeys a $(re^{r/D})^{-1}$ law (D = "Debye length"). Conditions of applicability of this theory are discussed, and effective cross-sections calculated. They approximately vary as E^{-2} (E = electron energy), and are often very large, larger than the effective cross-sections between electrons and neutral molecules; this explains the failure of the theories which treat the ionized media as "Lorentz's gases" when trying to predict the form of the distribution function of electron velocities: this distribution function is nearly always Maxwellian, but temperatures T_e that are much larger than the temperature T of the gaseous molecules. A.

537.533.75

8659. ON THE INTERPRETATION OF THE CHARACTERISTIC ENERGY LOSSES OF ELECTRONS IN THIN FOILS. R.H.Tredgold.
Physica, Vol. 22, No. 12, 1219-22 (Dec., 1956).

It is shown that certain of the features of characteristic energy losses of electrons in thin foils, which have hitherto been considered only to be explicable in terms of the plasma wave theory, may also be explained in terms of inter-band transitions. A.

537.533.79 : 621.385.833

8660. SPACE CHARGE NEUTRALIZATION BY IONS IN LINEAR FLOW ELECTRON BEAMS. N.C.Barford.
J. Electronics and Control, Vol. 3, No. 1, 63-86 (July, 1957).

The integro-differential equation of linear electron space charge flow in the presence of ions is obtained, using an empirical formula

for the cross-section for ion production by electrons based on experimental results. The influence of the ions may be represented by a single parameter, ϕ, which is a function of the potential and current density of the electron beam and of the gas pressure. Solutions of the flow equation are obtained for a wide range of values of ϕ. These show that for $\phi \geq 0.01$ ions are produced at such a rate that they can neutralize the electron space charge even when there exist appreciable fields to draw them off, whereas for $\phi \leq 0.01$ this neutralization is only achieved when the ions are trapped. Two examples are given of the numerical application of the theory to problems of practical importance. A.

537.534 : 621.384.611

8661. A CYCLOTRON FOR MEDICAL RESEARCH.
J.W.Gallop, D.D.Vonberg, R.J.Post, W.B.Powell, J.Sharp and P.J.Waterton.
Proc. Instn Elect. Engrs, Paper 2342M, publ. March, 1957 (Vol. 104B, 452-66).

Republication, with discussion, of the paper abstracted in Abstr. 3364 (1957).

537.534.3

8662. THE OMEGATRON AND ITS APPLICATIONS.
R.J.Warnecke, Jr.
Ann. Radioélect., Vol. 12, 258-81 (July, 1957). In French.

An account of the theory of the Omegatron is given and a simple construction described. The use of the device as a leak-detector, both by the normal and accumulation techniques, is described. The use of argon as a probe gas was studied. Resolving power was improved by using fields up to 5000 Oe. A description of an all-metal version of the tube is included. A.H.W.Beck

537.534.3

8663. ON THE USE OF DIFFERENTIAL ELECTROSTATIC FIELDS IN THE SPECTROSCOPY OF BEAMS OF CHARGED PARTICLES. M.I.Korsunskiĭ and V.A.Bazakutsa.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 5, 1029-31 (1957). In Russian.

The development of the doubly-focusing mass spectrometer is briefly reviewed and attention directed to the focusing properties of a differential electrostatic field of the type discussed by Barber (N.F.Barber, Proc. Leeds. Phil. Soc., Vol. 2, 427, 1933). An electrostatic mass spectrometer based on these principles is described. The particles, which are focused axially and radially, follow a circular path between suitably shaped electrodes. The dispersion is said to be an order of magnitude better than that obtainable from ordinary cylindrical electrodes. T.Mulvey

537.534.74

8664. STUDY OF THE SCATTERING OF 3.8 MeV TRITONS BY PROTONS IN NUCLEAR EMULSIONS. CURVES GIVING THE CROSS-SECTION IN THE CENTRE-OF-GRAVITY SYSTEM AS FUNCTIONS OF THE SCATTERING ANGLE AND THE ENERGY.
G.Baumann.
J. Phys. Radium, Vol. 18, No. 5, 337-44 (May, 1957). In French.

The total average cross-section in the energy band from 0 to 3.8 MeV of the elastic scattering of this beam has been determined as 2.1 ± 0.3 barns. The angular distribution has been determined between the angles of 10° to 170° in the centre-of-gravity system for the same energy band of the incident beam of tritons. A.

537.534.74

8665. THE SCATTERING OF POSITIVE IONS BY NEUTRAL ATOMS. D.W.Sida.
Phil. Mag. (Eighth Ser.), Vol. 2, 761-71 (June, 1957).

The interaction between a positive ion and a neutral atom is calculated from a statistical model which treats the electrons as a Fermi gas and considers the electrostatic forces between it and the nuclei, as well as the kinetic and exchange energies of the gas itself. This is applied to the case of Ca^{++} ions and neon atoms and of K^{+} ions and argon atoms. The former is extended to consider also neutral calcium atoms and neon atoms. The elastic scattering of these ions is calculated by the classical and also by the quantum method over an energy range up to about 15 keV using these interactions. The results have been applied to problems of meteor trails (Massey and Sida 1955) and the spread of a beam of ions due to multiple scattering. A.

537.534.74

8666. DEUTERON–PROTON SCATTERING AT 11.7 MeV.
R.O.Kerman and R.Nilson.
Phys. Rev., Vol. 107, No. 1, 200-2 (July 1, 1957).

Absolute differential scattering cross-sections for deuteron–proton scattering at an incident deuteron energy of 11.7 ± 0.15 MeV have been obtained by using Ilford C-2 nuclear plates as detectors, with an accuracy of about 1% at a number of angles from 70° to 150° in the centre-of-mass system. The results appear to be in good agreement with the cross-sections obtained by other experiments in this energy range. A.

537.534.74

8667. ELASTIC PROTON–PROTON SCATTERING AT 2.24, 4.40, AND 6.15 BeV. B.Cork, W.A.Wenzel and C.W.Causey, Jr.
Phys. Rev., Vol. 107, No. 3, 859-67 (Aug. 1, 1957).

Protons of the internal circulating beam of the Bevatron were scattered in a polyethylene target. Both scattered and recoil protons were detected by scintillation counters at angles which define elastic proton–proton events. An internal counter was located within a few inches of the beam to permit measurements at laboratory scattering angles as low as 2°. Absolute values are based on the calibration of the induction electrode that monitors the circulating beam. Total elastic cross-sections obtained by integrating the differential spectra are 17, 10, and 8 mb at 2.24, 4.40, and 6.15 BeV, respectively. The experimental angular distributions are consistent with the prediction of a simple optical model with a complex index of refraction at short range. A.

537.534.74

8668. POLARIZATION EXPERIMENTS IN PROTON–PROTON SCATTERING. T.V.Kanellopoulos and G.E.Brown.
Proc. Phys. Soc. A, Vol. 70, Pt 9, 690-702 (Sept., 1957).

Possible proton–proton polarization experiments and the information that can be gained from them are reported. The formalism is written down and formulae are listed from which a quantity which can be measured in such experiments can easily be obtained in terms of the theoretical quantities. The formalism of the statistical matrix for spin ½ particles and the representation of the scattering matrix in spin space is employed. The chief aim is to present a complete set of formulae covering all experiments which appear to be possible in the near future. A.

537.534.74

8669. ANALYSIS IN COINCIDENCE IN PROTON–PROTON SCATTERING. G.E.Brown and T.V.Kanellopoulos.
Proc. Phys. Soc. A, Vol. 70, Pt 9, 703-7 (Sept., 1957).

An elementary discussion of experiments involving analysis in coincidence is given. The case in which the incident beam is unpolarized is discussed in detail. Additional information that can be obtained if the incident beam is polarized is indicated, and the additional information which can be obtained with a magnetic field is briefly summarized. A.

537.534.75

8670. A STUDY OF ACCELERATED Li IONS BY THE NUCLEAR PLATE METHOD. J.P.Lonchamp.
J. Phys. Radium, Vol. 18, No. 4, 239-46 (April, 1957). In French.

Particles from a Be target bombarded by 375 MeV α-particles are selected by a magnetic field and detected by nuclear emulsions at different values of $H\rho$. The Li^7 group is identifiable, and its energy was deduced from the energy of protons of the same moment. Six points of the range–energy curve of Li^7 were measured. The transformation of the proton curve to the Li curve can be made by means of a range correction. The charge of Li^7 is given at 25 MeV and 9 MeV. A range-energy curve is finally proposed for Li ions in Ilford C2 nuclear plates. A.

537.534.7

8671. THE RANGE IN G5 NUCLEAR EMULSION OF PROTONS WITH ENERGIES 87, 118 AND 146 MeV.
M.W.Friedlander, D.Keefe and M.G.K.Menon.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 461-72 (Feb., 1957).

A comparison was made between the ranges of artificially accelerated protons in aluminium and in Ilford G5 photographic emulsion. The ranges in emulsion were obtained by direct measurement along the particle tracks, and those in aluminium by an attenuation method. The ranges of protons of three different energies were 19.31, 13.23 and 7.82 g/cm² in aluminium, and 22.85, 15.58 and 9.50 g/cm² in emulsion of density 3.791 g/cm³ conditioned to 58% relative humidity. The corresponding energies were 146.5 MeV and 117.9 MeV and 87.4 MeV. Assuming the range–energy relation for protons to be at present better determined for aluminium than for photographic emulsion, this experiment provides new information concerning the relation between particle range and energy in nuclear emulsion. A.

DISCHARGE TUBES. COUNTERS 537.54

537.542

8672. ROLE OF PHOTONS IN A SELF-QUENCHING GEIGER–MÜLLER COUNTER.
R.M.Chaudhri, M.Y.Khan and M.Yunas.
Nature (London), Vol. 179, 1364-5 (June 29, 1957).

Describes experiments on discharge spread in argon–alcohol filled countertubes; in some tests two counters were arranged in a single tube. The authors conclude that visible and u.v. light can cause cathode photoemission. J.D.Craggs

537.542 : 539.185

8673. DIBORANE-GAS FILLED COUNTING TUBES FOR MEASURING THERMIC NEUTRONS. O.J.Orient and E.I.Vizsolyi.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1722-8 (June, 1957).

A method for producing adequately pure diborane gas free from electron-negative impurities is described; further the results of comparative research work on diborane-filled and boron-fluoride filled counting tubes are given. According to the results of measurements, the operating characteristics of the diborane-filled tubes coincide with those of the boron-fluoride filled tubes, the only difference being that the efficiency of the diborane-filled tubes is double of that of the boron-fluoride filled tubes. A.

537.542

8674. DELAYS IN PROPORTIONAL COUNTERS.
H.C.Hamers, G.J.Sizoo, A.Marseille and T.J.de Boer.
Physica, Vol. 23, No. 3, 225-35 (March, 1957).

Delays in proportional counters, filled with A–alcohol, A–n-pentane, Kr–alcohol, Kr–n-pentane and Xe–n-pentane mixtures, are determined as a function of the voltage on the counters. From these data the values of the electron mobilities are derived in the region of F/p at about 0.1 or 0.2. A discussion in connection with coincidence measurements is given. A.

537.542 : 537.591.15

8675. THE RESPONSE OF A LIQUID SCINTILLATION COUNTER TO EXTENSIVE AIR SHOWERS OF LOW DENSITY. M.H.Brennan.
Nuovo Cimento, Vol. 6, No. 1, 216-25 (July, 1957).

A large area liquid scintillation counter suitable for experiments on extensive cosmic-ray air showers is described. Pulse height distributions are given for vertically incident penetrating particles, the sea-level cosmic-ray flux and air shower particles. It is found that the scintillator is a more sensitive detector of the particles in cosmic-ray air showers than is a tray of Geiger counters of the same area. The greater sensitivity of the scintillator is explained in terms of its greater detection efficiency for the low energy γ-rays present in an air shower. It is found that a value of 2.1 for the ratio of the density of γ-rays (as detected by the scintillator) to the density of electrons (as detected by the Geiger counter) is required to account for the increased sensitivity of the scintillation counter. A.

537.542

8676. A TRIGGERED SPARK COUNTER.
T.E.Cranshaw and J.F.de Beer.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1107-17 (May, 1957).

The behaviour of a triggered parallel plate spark counter has been investigated as a possible means of determining the trajectories of ionizing particles. Efficiencies, in an air-spaced counter, were 99%, with a rate of random breakdowns less than 1%. A.

537.542 : 537.311.33 : 539.16.08

8677. THE CHARACTERISTICS AND MECHANISM OF OPERATION OF GERMANIUM ELECTRON–HOLE ALPHA-COUNTERS. A.V.Airapetyants and S.M.Ryvkin.
Zh. tekh. Fiz., Vol. 27, No. 1, 95-105 (1957). In Russian.

The following observations were made on Ge p–n junctions used as counters of alpha and other charged particles. The magnitude of the output signal is comparable with that obtained in dielectric crystal counters; the counter characteristic has a good plateau; the time to reach maximum output signal varies from 2-3 μsec to 10 μsec for various specimens; p–n junctions can be used as counters at room temperature but the signal-to-noise ratio is improved by use at lower temperatures; polarization and some other defects of ordinary crystal counters are not found in p–n counters. Experimental results relating the parameters and geometry of the p–n counters with the magnitude and rate of rise of the output pulse agree with the given theory. A.F.Brown

537.542 : 621.374.32

8678. IMPROVEMENTS ON A MULTICHANNEL PULSE ANALYZER. S.Colombo, C.Cottini and E.Gatti.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 748-50 (March, 1957).

A development of the analyser described in Abstr. 3606 (1954).

537.542

8679. ACCURACY LIMITS IN THE MEASUREMENT OF TIME INTERVALS DEFINED BY SCINTILLATION COUNTER PULSES. S.Colombo, E.Gatti and M.Pignanelli.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1739-62 (June, 1957).

Accuracy limits of the time of occurrence of an event detected by a scintillation counter are investigated. Two methods "nonlinear" and "linear" for extracting time information from the output current pulse of the photomultiplier are compared taking into account statistics of photoelectron emission, transit time and multiplication spread in the phototube and finite width of the response of the phototube to one photoelectron. Resolution obtained by the "nonlinear" method is better, but the linear method dispenses with an amplitude selection of pulses. A.

537.542

8680. STEREOSCOPY IN BUBBLE CHAMBERS.
P.Bassi, A.Loria, J.A.Meyer, P.Mittner and I.Scotoni.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1729-38 (June, 1957).

Exact and approximate methods are given for the reconstruction of the position of a point in a bubble chamber, photographed with two cameras having parallel optic axes. In the appendix procedures are suggested for the direct reconstruction of a straight line and for the determination of the radius of curvature of a cylindrical helix with axis parallel to the optic axes. A.

537.542

8681. A PROPANE BUBBLE CHAMBER.
M.H.Alston, B.Collinge, W.H.Evans, R.W.Newport and P.R.Williams.
Phil. Mag. (Eighth Ser.), Vol. 2, 820-9 (June, 1957).

A propane bubble chamber of effective volume 1 litre has been constructed for experiments on the elastic scattering of low energy (< 40 MeV) π^+-mesons on hydrogen and carbon. Stereoscopic pairs of pictures are taken on 35 mm film with a stero angle of 90°. The design and operation of the chamber and associated equipment is described, and examples of pictures taken are shown. A.

537.543

8682. THE SPACE-CHARGE LIMITED FLOW OF CHARGED PARTICLES IN PLANAR, CYLINDRICAL AND SPHERICAL DIODES AT RELATIVISTIC VELOCITIES. E.W.V.Acton.
J. Electronics and Control, Vol. 3, No. 2, 203-10 (Aug., 1957).

Gives theoretical determinations of collector currents in diodes having planar, cylindrical and spherical electrode systems operating under conditions of space-charge limitation. The Langmuir (1913) and Child (1911) equations are extended to the case of relativistic velocities and the solutions are valid for any value of accelerating voltage. In the planar case a general power series solution is obtained by direct integration; in the cylindrical and spherical cases, three ranges of accelerating voltage are considered and solutions obtained. A.

IONIZATION. THERMIONICS 537.56/.58

537.561

8683. IONIZATION AND DISSOCIATION BY ELECTRON IMPACT. II. BORON TRIFLUORIDE AND BORON TRICHLORIDE.
J.Marriott and J.D.Craggs.
J. Electronics and Control, Vol. 3, No. 2, 194-202 (Aug., 1957).

For Pt I, see Abstr. 7493 (1956). Electron impact reactions at low pressures in BF_3 and BCl_3 were studied with a mass spectrometer. Positive and negative ions were investigated and the appearance potential data are discussed and interpreted. A.

537.562

8684. STUDY OF THE IONIZATION OF THE GASES OF PROPULSIVE JETS. A.Dauguet.
Ann. Télécomm., Vol. 12, No. 6, 235-45 (June, 1957). In French.

Experimental measurements of (i) the absorption of microwaves

and (ii) the conductivity between two electrodes in the flame of a static jet lead to values of the ionization density which are found to agree with those calculated on the Saha theory of thermal ionization. The conditions for which this theory may be expected to hold are discussed. J.Dutton

537.564

8685. PROBABILITY OF ELECTRON CAPTURE BY NEUTRAL ATOMS IN THREE-PARTICLE COLLISIONS. Yu.S.Sayasov.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 3, 548-9 (1957). In Russian.

The electron capture coefficient for $e + H + H_2 \rightarrow H^- + H_2$ is evaluated using the experimental data (Abstr. 5952/1956) for the inverse process. G.E.Brown

537.564

8686. IONIZATION OF GASES BY RECOIL ATOMS.
W.G.Stone and L.W.Cochran.
Phys. Rev., Vol. 107, No. 3, 702-4 (Aug. 1, 1957).

The value of W, the average energy required to produce an ion pair, has been measured in several gases for the recoil atoms due to the alpha-decay of ThC and ThC'. The method used compared proportional counter pulse heights from the first inch of alpha tracks with complete recoil tracks, auxiliary counters differentiating between the two by coincidence technique. For the recoils due to the decay of ThC, the following values of W (in eV per ion pair in the indicated gas) were obtained: CO_2, 102; C_3H_6, 99; C_2H_4, 104; He, 60; H_2, 81; CH_4, 111. The values for the decay of ThC' were found to be: CO_2, 99; C_3H_6, 92; C_2H_4, 90; He, 55; H_2, 68; CH_4, 96. A.

537.564

8687. MEASUREMENTS OF LARGE-ANGLE SINGLE COLLISIONS BETWEEN HELIUM, NEON, AND ARGON ATOMS AT ENERGIES TO 100 keV.
E.N.Fuls, P.R.Jones, F.P.Ziemba and E.Everhart.
Phys. Rev., Vol. 107, No. 3, 704-10 (Aug. 1, 1957).

Single collisions between ions and atoms have been studied at 25, 50, and 100 keV energies for the cases He^+ on He, He^+ on Ne, He^+ on A, Ne^+ on Ne, Ne^+ on A, and A^+ on A. The incident ion beam traversed a collision chamber containing a target gas whose pressure was maintained low enough to insure single interactions. The particles, which were scattered at each angle from 4° to 40°, passed through a pair of collimating holes with a resolution width of 1°. An electrostatic analyser and its associated detectors determined the number of scattered atoms in each state of charge, ranging from zero to seven times ionized. The percentages of the various charge states in the scattered beam are plotted in order to indicate the dependence of this quantity on scattering angle and energy for each of the systems studied. The differential cross-section for the scattering of particles has also been measured in each case and compared with values calculated classically from a Coulomb potential energy function modified by exponential screening. A.

537.564

8688. SOME EXPERIMENTS ON ELECTRON CAPTURE, ELECTRON LOSS AND IONIZATION.
F.J.de Heer, W.Huizenga and J.Kistemaker.
Physica, Vol. 23, No. 3, 181-96 (March, 1957).

The capture, loss and ionization cross-section measurements are carried out for H^+, He^+, N^+, N_2^+, Ne^+, A^+, Kr^+, I^+ and Tl^+ ions shot into hydrogen, neon and argon gas, in the energy region 2-25 keV. The cross-section results are interpreted with the parameter $a\Delta E/hv$; excited states have to be considered. Scattering over large angles is considered and some data about secondary emission of electrons on copper are given. A.

537.564

8689. IONIZATION BY POSITIVE IONS.
H.B.Gilbody and J.B.Hasted.
Proc. Roy. Soc. A, Vol. 240, 382-95 (June 11, 1957).

A method of measuring the ionization cross-section of atoms by positive ions is described, in which electrons are collected from single collisions of an ion beam passing through a gas at low pressures. Secondary electrons formed by the collisions of ions with surfaces are suppressed. Measurements are given for twenty-three cases, over energy ranges of ~ 5 to ~ 40 keV and ~ 100 to ~ 3 keV. The cross-sections fo not appear to conform to the simple adiabatic theory, but the size of cross-section in the adiabatic region appears to depend upon the reduced mass of the system. A.

537.572 : 537.533.92

8690. ENERGY OF IONIZATION BY ELECTRONS IN CRYSTALS OF GERMANIUM. V.S.Vavilov, L.S.Smirnov and V.M.Patskevich.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 6, 1020-2 (1957). In Russian.

The ionization energy in Ge due to bombardment by 5 to 15 keV electrons was measured at pressures of 10^{-6} to 10^{-4} mm Hg. A value of 3.7 ± 0.4 eV was found. No variation with pressure, energy of primary electrons or surface treatment was observed. J.B.Arthur

COSMIC RAYS 537.591

537.591

8691. COSMIC RAYS NEAR THE NORTH GEOMAGNETIC POLE IN THE SUMMERS OF 1955 and 1956. H.V.Neher.
Phys. Rev., Vol. 107, No. 2, 588-92 (July 15, 1957).

The experiments herein described are a continuation of similar experiments performed in previous years near the north geomagnetic pole. In 1954 low-energy particles were found at high altitudes which had the characteristics of protons with energies down to 150 MeV. In 1955 flights to higher altitudes (4 g cm^{-2}) indicated that these energies extended down to at least 100 MeV for protons. The numbers of both the high-energy particles (E > 1 BeV) and those of low energy, in 1955 were less than in 1954. On one flight in 1955 the very low-energy particles were missing. In 1956, these low-energy particles (< 300 MeV for protons) were missing completely. The "shape" of the ionization–depth curves at high altitudes appear to be a sensitive index of the presence or absence of these low-energy particles. In 1956 the "shape" of the curves at low pressure (< 100 g cm^{-2}) was similar to those of 1951 when the low-energy radiation was missing and when a "knee" was present in the latitude curve at high altitudes. It is inferred that a "knee" was also present in 1956 but not in 1955. The fluctuations were also large in 1955 compared with 1954. The average intensity of cosmic rays since 1954 has been decreasing with time as the sun approaches its maximum activity. This is in accordance with Forbush's relationship (Abstr. 4867/1955). However, in 1956 three of six flights showed intensities in the lower part of the atmosphere even less than any of the flights of 1937 at Saskatoon, Canada, in spite of the fact that the sun's activity in 1956 was less than in 1937. A

537.591

8692. SOLAR FLARE EFFECT ON THE COSMIC RAY MESON INTENSITY AT GULMARG. R.P.Kane and H.S.Ahluwalia.
Curr. Sci., Vol. 26, No. 3, 83-4 (March, 1957).

Here, at an altitude of 9000 ft, geom. latitude 23° 5' N, counter telescopes, containing 8 cm Pb interposed, have registered an increase of 10% ± 2% of the cosmic-ray intensity during the interval 8 a.m. to 12 noon on February 23, 1956. E.W.Kellerman

537.591

8693. INTENSITY AND ENERGY SPECTRUM OF FAST NEUTRONS IN COSMIC RADIATION.
S.Miyake, K.Hinotani and K.Nunogaki.
J. Phys. Soc. Japan, Vol. 12, No. 2, 113-21 (Feb., 1957).

The intensity and the energy spectrum of low energy neutrons at Mt. Norikura (2740 m above-sea level and 25°N geomagnetic latitude) were obtained by observing recoil protons with the randomly operated high-pressure cloud chamber filled with hydrogen gas at the pressure of 92 atm. The differential energy spectrum for neutrons in the energy range from 1 MeV to 15 MeV was found to be expressed by

$(1.2 \pm 40\%) \times 10^{-3} \times E^{-1.25 \pm 0.10}$ cm^{-2} sec^{-1} $sterad^{-1}$ MeV^{-1}.

The neutron flux is in conformity with what one would expect from the density of thermal neutrons. Connecting the present data with the others which were obtained by many investigations in different energy ranges, the energy spectrum of neutrons ranging from 1 eV to 10 BeV are discussed.

537.591

8694. OBSERVATION OF COSMIC-RAY NEUTRON INTENSITY AT GEOMAGNETIC LATITUDE 25°N. I. ATMOSPHERIC EFFECT
M.Kodama, K.Murakami and Y.Sekido.
J. Phys. Soc. Japan, Vol. 12, No. 2, 122-5 (Feb., 1957).

The absorption mean free path of neutrons in the atmosphere, deduced from the barometer effect observed at each station is 139 ± 5 g/cm^2, while 136 ± 2 g/cm^2 was obtained from the intensity difference between two stations at different altitude.

537.591.1

8695. AN OBSERVED COSMIC-RAY FLUX OF LIGHT ELEMENTS AT 41° N GEOMAGNETIC LATITUDE.
J.H.Noon, A.J.Herz and B.J.O'Brien.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 854-65 (April, 1957).

The relative abundances of the different charge groups of heavy cosmic-ray nuclei under less than 12 g/cm² of atmosphere and packing, were measured in a stripped-emulsion stack flown at geomagnetic latitude 41° N. A minimum potential range of 4.5 cm in emulsion was required for the acceptance of any track. Identification was based on measurements of δ-ray density. Charge calibration was obtained from grain counts and gap-length measurements on identified protons and deuterons coming to rest in the emulsion. The flux of beryllium and boron was found to be comparable with that of carbon, nitrogen and oxygen nuclei. A.

537.591.1

8696. MEASUREMENT OF THE ALPHA PARTICLE FLUX AT 41° N GEOMAGNETIC LATITUDE USING NUCLEAR EMULSIONS.
B.J.O'Brien and J.H.Noon.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1463-8 (June, 1957).

Values obtained for the α-particle flux by counter measurements at 41°N over the U.S.A. are significantly higher than those obtained using nuclear emulsions at 41°N over Sardinia. The authors have measured the α-particle flux at 41°N over the U.S.A. using nuclear emulsions and the results in agreement with counter measurements are higher than those over Sardinia. These measurements are of interest in view of the proposed modifications to geomagnetic coordinates. A.

537.591.1

8697. THE FLUX OF PRIMARY COSMIC RAY α-PARTICLES OVER SARDINIA. H.H.Aly and C.J.Waddington.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1679-84 (June, 1957).

The flux of α-particles in the primary cosmic-radiation has been determined over Sardinia, geomagnetic latitude, λ, 41°N. A nuclear emulsion technique was employed. The result obtained of 72 ± 9 α-particles/m².sr.sec, was considerably higher than the only other directly comparable experimental result, but was in good agreement with the predicted value. The implications of this result are discussed. A.

537.591.1

8698. THIN DOWN AND BREAKUP OF A LARGE Z COSMIC RAY PRIMARY. A.G.Barkow, B.Chamany and R.E.McDaniel.
Nuovo Cimento, Vol. 6, No. 1, 125-9 (July, 1957).

A high Z primary cosmic-ray particle is observed in G-5 emulsion exposed at an altitude of 104 000 ft. Thin-down measurements indicate a value of Z between 24 and 40. The thin-down is accompanied by a partial breakup which permits an interesting determination of the charge on the primary, and suggests that the charge on the primary is between 35 and 40. A.

537.591.1

8699. THE CHARGE DISTRIBUTION OF MULTIPLY CHARGED NUCLEI IN THE PRIMARY COSMIC RADIATION. I. THE LIGHT AND MEDIUM NUCLEI. C.J.Waddington.
Phil. Mag. (Eighth Ser.), Vol. 2, 1059-78 (Sept., 1957).

The charge distribution of multiply charged nuclei in the cosmic radiation with charges of less than ten, has been investigated with a nuclear emulsion detector. The individual charges were determined by two independent methods of ionization measurement, δ-ray counting and blob-gap counting on the cores of tracks. The close similarity of the charge spectra obtained from these measurements provides an important check on the reliability of the charge determinations. The fluxes of nuclei of different charge groups are given, and it is shown that the ratio of light to medium nuclei at a mean depth in the atmosphere of 15 g/cm² is 0.47 ± 0.07, while at the top of the atmosphere it is 0.37 ± 0.07. These results are compared with those obtained by earlier workers. The use of charge indicating interactions in the calibration of the charge measurements is diccussed in an appendix. A.

537.591.15

8700. THE DENSITY SPECTRUM OF COSMIC-RAY EXTENSIVE AIR SHOWERS AT 230 m ALTITUDE. A.Zawadzki.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 5, No. 2, 147-53 (1957). In French.

An extensive shower set has been used to determine the coefficient γ of the shower density spectrum and its dependence on density. It is found that $\gamma = 1.323 + 0.064 \ln(1 + 0.043\rho_{ln})$ where ρ_{ln} is the logarithmic density. This result is compared with the results of other workers. E.W.Kellermann

537.591.15

8701. ON THE FUNCTION OF ANGULAR AND SPACE DISTRIBUTION OF PARTICLES AT THE MAXIMUM OF A CASCADE SHOWER. V.V.Guzhavin and I.P.Ivanenko.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 3, 533-6 (1957). In Russian.

It is hoped to compute the above function using an extension of the method described by Eyges and Fernbach (Abstr. 5528/1951) and Fernbach (Abstr. 5529/1951), taking into account ionization losses. An account of the method is given and computations are stated to be in progress. S.Chomet

537.591.15

8702. MULTIPLE MESON PRODUCTION AND ANGULAR DISTRIBUTION OF SHOWER PARTICLES PRODUCED IN COSMIC RAY "JETS". L.v.Lindern.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 491-501 (Feb., 1957).

In nuclear emulsions exposed to the cosmic radiation, showers have been studied which are produced by singly charged or neutral particles, mainly perhaps nucleons (i.e. "jets" or mesonic showers; their total number being 22). The analysis has been restricted to events whose primary energies are greater than 20 GeV, and the number of visible shower particles of which are equal to or greater than 8. An upper limit of $N_h = 3$ for the "heavy" and "grey" prongs has been chosen for each event. (The total number of charged shower particles is 255 and of "grey" or "heavy" prongs is 28). Such selected showers are interpreted in terms of multiple meson production, and the shower particles are supposed to be mainly mesons produced at one single nucleon—nucleon collision. Within the spread of primary energies observed (20-500 GeV) the angular distribution of shower particles shows a significant deviation from isotropic emission in the centre of mass system of the two colliding nucleons. A.

537.591.15

8703. ON THE COSMIC RAY PENETRATING SHOWERS UNDERGROUND.
S.Higashi, T.Oshio, H.Shibata, K.Watanabe and Y Watase.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 592-6 (March, 1957).

In 218.5 hours of reception time, 13 penetrating showers were obtained with a large multiplate cloud chamber, at the depth 50 m w.e. from the top of the atmosphere. Five of these showers were produced in lead plates in the chamber. The rate of the number of penetrating showers produced by secondary rays (probably π-mesons) to that by primary rays (probably μ-mesons) was found to be $\frac{2}{3} \sim \frac{1}{1}$. Therefore it seems impossible to neglect the contributions of secondary particles to the production of penetrating showers underground. The apparent cross-section of μ-mesons for the penetrating shower production is estimated as $(0.5 \pm 0.3) \times 10^{-30}$ cm²/nucleon and the interaction mean free path of secondaries is (157 ± 90) g/cm². A.

537.591.15

8704. ON THE MULTIPLE PENETRATING PARTICLES UNDERGROUND.
S.Higashi, T.Oshio, H.Shibata, K.Watanabe and Y.Watase.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 587-607 (March, 1957).

Penetrating showers have been observed at the depth of 50 m w.e. from the top of the atmosphere by means of a large multiplate cloud chamber, the sensitive volume of which is 80 x 70 x 40 cm³ and which contains 15 lead plates of thickness 1 cm each. In 218.5 hours of reception time, four events each involving from 4 to 9 parallel penetrating particles falling on to the cloud chamber simultaneously were observed in addition to a number of penetrating showers. The parallel penetrating particles show neither nuclear interaction with lead nuclei nor appreciable scattering in the lead plates. It is considered that these events consist of μ-mesons having energies higher than 0.5 GeV at this depth. They were named the "Multiple Penetrating Particles" (M.P.P.), about which following conclusions were obtained: (i) If they are the secondary particles of large penetrating showers produced in the overlaying rock above the apparatus, the statistical hypothesis that the origin of the shower is within 6 m over the apparatus can be abandoned with a significant level smaller than 0.01. The multiplicity of π-mesons produced in such a shower would be more than 300, even if all the secondaries, undergoing absorption with a mean free path λ = 145 g/cm² (= $2\lambda_{gr}$, λ_{gr}: geometrical interaction mean free path in rock), decayed into μ-mesons. (ii) If they belong to the penetrating component of air showers which traverse the earth down to this depth, the size and the frequency of those events cannot be interpreted on the assumption of the flat structure function of the penetrating component as usually employed. A.

537.591.15

8705. A POSSIBLE INTERPRETATION OF THE MULTIPLE PENETRATING PARTICLES. S.Hayakawa.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 608-14 (March, 1957).

See preceding two abstracts. Some of the multiple penetrating particles are regarded as a bundle of μ-mesons produced in the atmosphere. It is suggested to interpret this observation in terms of the heavy primary nucleus that is split into nucleons by the collision with an air nucleus, each of the split nucleons producing multiple π-mesons which subsequently decay into μ-mesons of high energies. A.

537.591.15

8706. EXPERIMENT ON PENETRATING SHOWERS PRODUCED BY μ-MESONS IN A LARGE CLOUD-CHAMBER UNDERGROUND. D.Kessler and R.Maze.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1540-63 (June, 1957). In French.

A large cloud-chamber containing 12 Pb plates (1 cm thick) and internal Geiger counters has been operated for 5000 h at 65 m w.e. underground. 28 penetrating showers produced inside the chamber by high-energy μ-mesons have been observed. These showers have been analysed with the following results: (1) As far as the relative number of secondary $\pi^{\pm}$, π^{0} and protons is concerned, the penetrating showers observed underground do not differ significantly from those obtained at sea-level and mountain altitudes. The observed mean free path for star production and nuclear scattering by the ionizing secondaries (the outgoing μ-meson being excluded) is 233 ± 52 g/cm^{-2} Pb. This corresponds to a geometrical mean free path, taking into account the finite plate thickness. (2) The angle of deviation of the μ-meson in the interaction is shown to be very small, less than 2^{0} in most cases. This is about one order of magnitude less than the estimated ratio q/E of energy transfer to primary energy, in agreement with the interpretation of the events in terms of inelastic photo-nuclear interactions. (3) The mean number of ionizing penetrating secondaries (without the outgoing μ-meson) is 3.7. The mean energy of the observed events has been estimated from the electron cascades produced by disintegration of π-mesons: 16 GeV. (4) The observed cross-section of $(0.43 \pm 0.08) \times 10^{-30}$ cm^{2}/nucleon for production of penetrating showers of more than 12 GeV by μ-mesons at 65 m w.e. underground is in good agreement with the predictions of a refined Williams–Weizsäcker theory and an assumed photonuclear cross-section of 10^{-28} cm^{2}/nucleon at those high energies. (5) There is some evidence that the secondaries are not emitted isotropically in the center-of-momentum system of the virtual photon and the target nucleon. An anisotropic distribution of the type $(1 + \cos\Phi)\,d\Omega$ in the c.m. system would agree with the observed angular distribution in the laboratory. In the same experiment, 12 cases of parallel non-interacting penetrating particles were observed, presumably μ-mesons from extensive air showers. Two pictures show as much as 9 and 11 parallel μ-mesons in the illuminated region of the cloud-chamber, which leads to a density of about 55 particles per m^{2} at 65 m w.e. and is estimated to arise from air-showers of about 3.10^{18} eV. This energy estimate would agree with the observed frequency. A.

537.591.15

8707. TIME VARIATIONS OF EXTENSIVE AIR SHOWERS. F.J.M.Farley and J.R.Storey.
Proc. Phys. Soc. B, Vol. 70, Pt 9, 840-4 (Sept., 1957).

Extensive air showers corresponding to primary cosmic rays ranging from 10^{14} to 3×10^{15} eV were recorded at Auckland for the year 1955. The results do not confirm the large sidereal diurnal effect reported previously. A.

537.591.15

8708. ALTITUDE DEPENDENCE OF EXTENSIVE AIR SHOWERS ACCORDING TO VARIOUS MODELS OF THE ELEMENTARY ACT OF NUCLEAR COLLISION. V.V.Guzhavin and G.T.Zatsepin.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 365-6 (1957). In Russian.

Comparison of the calculated results with experimental data strongly favours the assumption that the incident nucleon only loses ~30% of its energy, E, in the primary collision for $E \sim 5 \times 10^{12}$ eV. At higher energies (10^{18} eV) the data suggest a greater energy loss. W.O.Lock

537.591.15 : 537.542

RESPONSE OF A LIQUID SCINTILLATION COUNTER TO EXTENSIVE AIR SHOWERS OF LOW DENSITY. See Abstr. 8675

537.591.5

8709. ON THE POSITIVE TEMPERATURE EFFECT IN THE COSMIC RADIATION AND THE $\pi-\mu$ DECAY. H.Trefall.
Physica, Vol. 23, No. 1, 65-72 (Jan., 1957).

The temperature effect due to competition between disintegratio of π-mesons and absorption through nuclear interactions is discusse It is shown that the magnitude of this effect as much depends on the probability for production of new π-mesons in meson-initiated interactions as it depends on the interaction mean free path. An attenuation length of the π-meson component is defined to represent the loss of π-mesons through nuclear interactions, and it is shown that this quantity and not the interaction mean free path itself determines the magnitude of the positive temperature effect at a given mean life of the π-mesons. A simple but fairly accurate approximate formula for the temperature effect has been developed. A comparison with experimental results shows that the attenuation length of the π-meso component is hardly less than twice the interaction mean free path. A.

537.591.8

8710. NEW EXPERIMENTAL EVIDENCE FOR THE TUNNEL THEORY OF COSMIC RAY "JETS". C.B.A.McCusker and F.C.Roesler.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1136-44 (May, 1957).

The predictions of the tunnel theory of cosmic-ray jets are compared with recent experimental evidence, particularly with the detailed data of the jet found by Debenedetti et al. Excellent agreement is found between the new experimental data and the earlier theoretical predictions. A list of 74 jets with $\gamma_{p} \geq 500$ is given in an appendix. A.

537.591.8

8711. COSMIC RAY STARS IN NUCLEAR EMULSIONS AT THE EQUATOR AND AT HIGH ALTITUDE. B.Jongejans, F.Schurink and D.J.Holthuizen.
Physica, Vol. 23, No. 2, 164-8 (Feb., 1957).

Results are reported of a nuclear emulsion experiment perform ed at 4840 m above sea-level and 0° latitude. For uncovered plates a star production of 10.1 ± 0.9 stars per cm^{3} emulsion per day at a pressure of 560 cm^{-2} is found, being a minimum as compared to data at other latitudes. Within the limits of error, no attenuation is observed for the total star number in 30 cm of lead. For high energy star producing radiation an attenuation length in lead of 550 g cm^{-2} with a lower limit of 310 g cm^{-2} resulted. The number of p stars varies approximately as the number of all stars with latitude. The importance of several checks when making emulsion measurements is stressed. A.

MAGNETISM 538

538

8712. THE PROPAGATION OF CLASSICAL MAGNETIC WAVES IN A FLUID OF MAGNETIC DIPOLES. G.Karpman and J.P.Vigier.
C.R. Acad. Sci. (Paris), Vol. 244, No. 21, 2577-80 (May 20, 1957). In French.

A continuation of Abstr. 7204 (1957). The equation of motion i under certain circumstances identical with that applicable to quanti mechanical spin-waves. E.P.Wohlfart

538.1

8713. ON THE SUSCEPTIBILITY OF A FERROMAGNETIC ABOVE THE CURIE POINT. C.Domb and M.F.Sykes.
Proc. Roy. Soc. A, Vol. 240, 214-28 (May 21, 1957).

Series expansions for the susceptibility of a ferromagnetic at high temperatures are examined in detail to estimate the curvatur of the reciprocal of the susceptibility immediately above the Curi point. For an Ising model with spin $\frac{1}{2}$ a substantial number of ter of the series are available, and the series is well behaved (i.e. th coefficients vary smoothly). The asymptotic behaviour of the coef ficients can be conjectured with fair confidence, and a closed form ula can be derived based on this conjecture. For an Ising model with spin greater than $\frac{1}{2}$ fewer terms of the series are available, the series is still well behaved, and an extrapolation can again be undertaken fairly confidently. For the Heisenberg model with spi $\frac{1}{2}$ the behaviour of the coefficients is considerably more erratic a the predictions are more tentative. It is concluded generally that the curvature of the reciprocal susceptibility depends primarily on

the lattice structure and little on the type of interaction; that there is little variation between the different types of two-dimensional, and different types of three-dimensional lattice, although there is a marked difference between two- and three-dimensional lattices. The experimental curve of Weiss and Forrer for nickel is examined, and it is found that the data can be fitted quite well by the extrapolation formula for a three-dimensional lattice. It is thus possible to account for the experimental results assuming only short-range interatomic forces. A.

538.221

8714. OBSERVATIONS ON THE MAGNETIC TRANSITION IN HEMATITE AT −15° C. G.Haigh.
Phil. Mag. (Eighth Ser.), Vol. 2, 877-90 (July, 1957).

An examination is made of the magnetic behaviour of hematite, αFe_2O_3, in the region of the antiferromagnetic transition temperature (−15° C). In this examination it is shown that the magnetic properties of hematite may be ascribed to two magnetically independent components of ferromagnetism, one dependent upon the antiferromagnetic transition whilst the other is independent of this transition. The magnetic properties of these two components have been determined firstly from a series of measurements with an astatic magnetometer, and then, by direct measurement at low temperature (−75° C), the magnetic properties of one component have been measured directly. These observations are critically discussed with reference to the magnetic structure for hematite proposed by Néel, and the inadequacy of this magnetic structure in accounting for some of the observations is pointed out. A.

538.222 : 536.48 : 537.311.33

8715. MAGNETIC PROPERTIES OF PURE AND N-TYPE GERMANIUM AT LIQUID HELIUM TEMPERATURES. F.T.Hedgcock.
J. Electronics, Vol. 2, No. 6, 513-28 (May, 1957).

The magnetic susceptibility of samples of n-type germanium of various charge carrier densities has been measured between 4.2° K and room temperature. An anomalous low temperature paramagnetism has been observed in high purity germanium. Specimens with large charge carrier concentrations, which may be classed as "degenerate" samples, afford an experimental situation in which the onset of charge-carrier degeneracy can be followed by lowering the temperature alone. For a particular impurity concentration range, in the non-degenerate samples, the observed susceptibility results can be explained by assuming the usual activation process in extrinsic semiconductors. Below this concentration, it seems necessary to suggest the existence of conduction in an impurity band. Using these results an estimate of the effective electron mass in the impurity band can be made. A.

538.222 : 536.48

8716. MEASUREMENTS OF THE MAGNETIC ANISOTROPIES AND THE THERMODYNAMIC TEMPERATURES OF POTASSIUM CHROMIUM ALUM BELOW 1° K.
J.A.Beun, A.R.Miedema and M.J.Steenland.
Physica, Vol. 23, No. 1, 1-25 (Jan., 1957).

The magnetic susceptibility of $CrK(SO_4)_2.12H_2O$ has been studied in zero external field for different amplitudes of the measuring field. The dependence of the susceptibility on the direction of an external transverse field is described. The anistropy pattern measured in this way at low entropies, proves to depend on the strength of the field and the entropy. The susceptibility in longitudinal fields has been measured and both magnetization curves and temperature variations along isentropics have been derived from these measurements. New determinations of the thermodynamic temperatures are discussed, giving marked differences with previous results. The discussion gives a comparison between $CrK(SO_4)_2.12H_2O$ and $CrCH_3NH_3(SO_4)_2.12H_2O$ based on the occurrence of ferromagnetic walls between antiferromagnetic domains. The variation of the susceptibility with entropy and in external fields has been interpreted by means of a recent theoretical study of M.C.M.O'Brien on the antiferromagnetic state in chrome alums. In addition the new temperature scale for this salt and some consequences of this scale are discussed. A.

538.222

8717. MEASUREMENTS ON THE MAGNETIC SUSCEPTIBILITY OF WHITE TIN AND COPPER DOWN TO LIQUID HELIUM TEMPERATURES. A.van Itterbeek and W.Duchateau.
Physica, Vol. 23, No. 2, 169-72 (Feb., 1957).

For copper a constant value is found for the susceptibility between room temperature and 20° K. At low temperatures the susceptibility increases strongly, which is due to the small amount of nickel and iron (0.0003%) present in the sample. For the polycrystalline tin, which is paramagnetic, a decrease of 16% is found for the susceptibility between room temperature and 2° K. For a single crystal of tin a decrease of 10% only was found. A.

538.222 : 536.48

8718. PARAMAGNETIC RELAXATION IN IRON AMMONIUM ALUM AND DILUTED IRON AMMONIUM ALUM AT VERY LOW TEMPERATURES. L.C.van der Marel, J.van den Broek and C.J.Gorter.
Physica, Vol. 23, No. 5, 361-77 (May, 1957).

Relaxation measurements have been performed on three samples of iron ammonium alum and a number of diluted iron aluminium alums at liquid helium and liquid hydrogen temperatures and in alternating magnetic fields at frequencies below 1300 c/s. As the relaxation parameters of the diluted alums are very long, a new amplifier device has been constructed which makes it possible to do accurate measurements in alternating magnetic fields down to 3 c/s. In the liquid hydrogen temperature region the relaxation parameters of only the 1 : 61 diluted alum could be measured and that is why the discussion in this paper is limited to the results obtained at liquid helium temperatures. The experimental dispersion and absorption curves are compared with those which follow from the thermodynamical theory of Casimir and Du Pré. Considerable deviations have been found with the salts which have a poor heat contact with the surrounding liquid helium and to a lesser extent with the salts which contain physical impurities. The relaxation parameters depend on the concentration of the magnetic ions and also on the above mentioned heat contact. Qualitative agreement is obtained if it is supposed that the heat developed in the spin system is transported to the bath by means of the lattice oscillators which are excited by transitions in the spin system. A.

538.222 : 536.48 : 536.631

MAGNETIC SUSCEPTIBILITIES OF ALLOYS OF CERIUM WITH LANTHANUM AT LOW TEMPERATURES. See Abstr. 8573

538.242

8719. NEW MEASUREMENTS OF THE GYROMAGNETIC RATIOS OF IRON AND NICKEL. A.J.P.Meyer and S.Brown.
J. Phys. Radium, Vol. 18, No. 3, 161-8 (March, 1957). In French.

Gyromagnetic measurements undertaken to reveal the source of discordance between previous experimental results are described. It is shown that a systematic error was responsible for the incorrect gyromagnetic ratio of approximately 1.00 (mc/e) found in some previous measurements by the Einstein–de Haas method. After correction of these values the results of different authors are found to be in good agreement. An apparatus with a moving coil for the resonant measurement of the Einstein–de Haas effect is described. The new experiments give for iron ρ (e/mc) = 1.035 ± 0.004 in agreement with the results of other authors. For nickel one finds ρ (e/mc) = 1.078 ± 0.005, a value close to that found by Scott. It is shown that the values in the neighbourhood of 1.04 found previously for nickel are erroneous for various reasons. A.

538.244

8720. MAGNETIC SATURATION IN ALLOYS OF NEODYMIUM AT LOW TEMPERATURES. J.M.Lock.
Phil. Mag. (Eighth Ser.), Vol. 2, 726-32 (June, 1957).

The magnetization of alloys of neodymium with lanthanum has been measured from room temperature down to 1.5° K. Above about 15° K the susceptibility is field-independent and obeys a Curie–Weiss law modified by a small temperature-independent paramagnetic terms, $\chi = C/(T - \theta) + K$. The Curie constant C gives effective atomic moments for all alloys in approximate agreement with the theoretical value for the Nd^{3+} ion, 3.62 μ_B per atom. At lower temperatures the alloys show striking saturation effects, and it is suggested that this can be accounted for in terms of a model in which the magnetic interactions between neodymium atoms are anti-ferromagnetic for nearest neighbours but ferromagnetic for more distant neighbours. A.

538.245

8721. THE MAGNETIZATION OF COBALT–MANGANESE AND COBALT–CHROMIUM ALLOYS. J.Crangle.
Phil. Mag. (Eighth Ser.), Vol. 2, 659-68 (May, 1957).

Magnetization measurements on the hexagonal and the face-centred cubic phases in several ferromagnetic Co-rich alloys in

these systems have been made. By the use of suitable extrapolation procedures, the magnetic moments of both phases in each system at the absolute zero have been estimated. In the Co—Mn alloys there is a significant difference in the dependence of moment on composition between the two phases. This is not the case in the Co—Cr alloys, where the rate of change of moment with composition of both phases is the same. A.

538.245

8722. THE ANHYSTERETIC MAGNETIZATION OF PERMANENT MAGNET ALLOYS. E.P.Wohlfarth.
Phil. Mag. (Eighth Ser.), Vol. 2, 719-25 (June, 1957).

Calculations on the basis of the single domain treatment are reported of the anhysteretic magnetization, the anhysteretic remanent magnetization and the initial magnetization for a simple model of a permanent magnet alloy, and the results are compared with experimental curves for Alcomax III (Gould and McCaig, 1954). A.

538.245 : 536.49

8723. PROCESSES OCCURRING DURING THE HEAT TREATMENT OF ALCOMAX. A.G.Clegg and M.McCaig.
Proc. Phys. Soc. B, Vol. 70, Pt 9, 817-22 (Sept., 1957).

The permanent-magnet alloy Alcomax has been investigated after different heat treatments using two techniques. Curves of saturation intensity against temperature have been obtained using a Sucksmith balance, and curves of coercivity against temperature by extraction from a solenoid. It is concluded that maxima in the coercivity curves are associated with subsidiary Curie points. Reversible changes in room-temperature coercivity produced between 600°C and 700°C are also associated with the appearance and disappearance of subsidiary Curie points. A.

538.245 : 536.49

8724. THE UNUSUAL MAGNETIC PROPERTIES OF QUENCHED ALCOMAX III. M.McCaig.
Proc. Phys. Soc. B, Vol. 70, Pt 9, 823-6 (Sept., 1957).

If the permanent-magnet alloy Alcomax III is quenched from a high temperature instead of the usual treatment it has the properties of a rather unusual soft magnetic material. The permeability is almost constant up to flux densities over 5000 gauss and the ratio of remanence to saturation intensity is less than 0.1. Details of these properties are given and their theoretical implications considered. A.

538.245

8725. RADIATION MAGNETIZATION. C.H.Becker.
Z. Phys., Vol. 148, No. 3, 391-401 (1957).

Radiation magnetization represents a new electron induction effect within ferrites resulting in real permanent magnetization, dynamically induced and detected by means of microwaves. A.

538.27 : 536.48

8726. DETERMINATION OF THE FERMI SURFACE BY THE DE HAAS—VAN ALPHEN EFFECT. A.Marchand.
J. Phys. Radium, Vol. 18, No. 6, 403-7 (June, 1957). In French.

Reviews the De Haas—Van Alphen effect with stress on its use for the determination of the Fermi surface. The theory of the underlying phenomenon is analysed, the experimental technique is outlined and the results so far obtained are given. A.

ELECTROMAGNETISM. ELECTRODYNAMICS 538.3/.5

538.3

8727. STABILITY OF PLASMAS CONFINED BY MAGNETIC FIELDS. M.N.Rosenbluth and C.L.Longmire.
Ann. Phys. (New York), Vol. 1, No. 2, 120-40 (May, 1957).

Whereas previous studies of this problem have started from the magnetohydrodynamic equations, closer attention is here paid to the motions of individual particles. The results are similar to, but more general than, those which follow from the magnetohydrodynamic equations. A.

538.3

8728. A SPINOR FORM OF THE ELECTROMAGNETIC EQUATIONS. G.Bodiou.
J. Phys. Radium, Vol. 18, No. 3, 169-72 (March, 1957). In French.

Contains a description of the general electromagnetic field and a transcription of the Maxwell—Lorentz equations in terms of first-rank spinors in space-time: Any real bivector is the dual (or ortho-complementary) of the sum of the electromagnetic densities determined by two spinors compounded with their respective "lacunal". The general solution of the Maxwell—Lorentz equations is of this form, its two generating spinors being solutions of suitable equation In vacuum, and for a large class of fields, these two spinors are solutions, suitably interrelated, of the Dirac equation for zero-mass corpuscules. A

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56

8729. GROWING ELECTROMAGNETIC WAVES. V.A.Bailey.
Phys. Rev., Vol. 106, No. 6, 1356 (June 15, 1957).

Appeal to the principle of relativity refutes Piddington's conclusion (Abstr. 3037/1956) that the growth of e.m. waves predicted by the electromagnetoionic theory is spurious.

L.Pincherle

538.56

8730. ON A MACROSCOPIC MEASUREMENT OF THE SPIN OF ELECTROMAGNETIC RADIATION. G.Toraldo di Francia.
Nuovo Cimento, Vol. 6, No. 1, 150-67 (July, 1957).

The spin of electromagnetic radiation can be revealed at micro wave frequencies by the torque exerted by a circularly polarized wave upon a screen which can conduct current only parallel to a gi direction. In order to make an accurate quantitative measurement, one has to know the angular momentum cross-section of the screen The first few terms of a series expansion of the cross-section are evaluated, with the assumption that the screen is a circular disk whose radius is small with respect to the wavelength. In order to assess the accuracy with which the polarization must be circular, also the imaginary part of the cross-section is evaluated. Explicit expressions are given for the scattered field over the screen. The feasibility of the experiment is discussed.

538.566 : 538.61

8731. TENSORIAL THEORY OF MAGNETIC ROTARY POWER. Y.Le Corre.
J. Phys. Radium, Vol. 18, No. 5, 312-17 (May, 1957). In French.

The author gives the most general linear relations suitable for the magnetic rotatory power in non-absorbing media and studies th influence of the symmetry upon these tensor equations, taking into consideration the magnetic anisotropy of electromagnetic wave propagation. A general definition of magnetic rotatory power is given, the variation of which is calculated according to the direction of propagation.

538.5

8732. HIGH-FREQUENCY SCATTERING OF ELECTROMAGNETIC WAVES. D.S.Jones.
Proc. Roy. Soc. A, Vol. 240, 206-13 (May 21, 1957).

The assumption that the illuminated region and the penumbra of a body scatter independently at high frequencies is used to obta scattering coefficients for perfectly reflecting convex bodies in pl electromagnetic and sound waves. The formulae involve only the scattering coefficients of the circular cylinder and the geometry c the shadow boundary. One general result is that the electromagne scattering coefficient of a solid of revolution, when the direction o propagation of the incident wave is along the axis of revolution, is the average of the sound-hard and sound-soft scattering coefficien

538.566 : 621.396.67

8733. ON THE PROBLEM OF THE PLANE OF PROPAGATION OF THE HORIZONTAL ELECTRIC DIPOLE.
G.Boudouris and D.Ilias.
J. Phys. Radium, Vol. 18, No. 7, 453-4 (July, 1957). In French.

A method, other than the classical one making use of the Her vector, is given for a more rapid solution of the propagation prob lem concerning the field radiated from a horizontal electric dipol over a flat earth. By means of this method, the problem is reduc to the previous cases which are supposed as known, of the vertica electric dipole and the horizontal elementary loop.

MOLECULAR AND ATOMIC STRUCTURE

539.1

THEORY OF SOLID STATE 539.11

539.11

8734. PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON ELECTRON TRANSPORT IN METALS AND SOLIDS.
Canad. J. Phys., Vol. 34, No. 12A, 1171-423 (Dec., 1956).

This conference was held at the National Research Laboratories, Ottawa, in September 1956. Abstracts of the papers will be published individually.

539.11

8735. A COLLECTIVE DESCRIPTION OF ELECTRONS IN SOLIDS. P.Nozières.
C.R. Acad. Sci. (Paris), Vol. 244, No. 17, 2236-38 (April 24, 1957). In French.

Outlines a method of generalizing the work of Bohm and Pines (Abstr. 1278/1954) to electrons in a periodic potential. The condition for the existence of plasmons, the effect of screening on the exchange energy, and the dispersion relation for the plasma frequency ω are given in terms of the excitation frequencies ω_{no} and generalized oscillator strengths $f_{on}(k)$ which correspond to transitions of the system when there is only a short-range interaction between the electrons. The results depend on a perturbation treatment of the electron–plasmon interaction which converges if the fraction of the $f_{on}(k)$ corresponding to $\omega_{no} \sim \omega$ is small. D.M.Edwards

539.11

8736. THE LORENZ NUMBER. P.J.Price.
I.B.M. J. Res. Developm., Vol. 1, No. 2, 147-57 (April, 1957).

The theory of the Lorenz number of a conducting crystal is developed for the common models of the electron assembly. For the one-electron model it is shown that, provided scattering is elastic to an approximation which is examined, the Lorenz number is equal to the square fluctuation of the thermoelectric power. For the phenomenological band model an equivalent result is obtained. It is hypothesized that these results are special cases of a more general one. Some applications, including the theory of the bipolar anomaly for semiconductors, are discussed. A.

539.11 : 548.7 : 530.145

8737. FINITE GROUPS OF SYMMETRY AND DETERMINATION OF SOLUTIONS OF THE SCHRÖDINGER EQUATION. L.Mariot.
J. Phys. Radium, Vol. 18, No. 5, 345-56 (May, 1957). In French.

The determination of energy levels of valence and conduction bands of a crystal is a problem not accurately resolved; one has to use approximation methods in order to find solutions of the Schrödinger equation applied to an electron of the crystal. The methods hitherto proposed depend on a variational principle; they all lead to the resolution of a secular equation of high degree if sufficient precision is wanted. Several chief points can be stated: (a) How to determine the potential of the crystal; (b) What trial functions will be chosen to express the variational principle; (c) How to resolve numerically a determinant whose degree may reach one hundred. Only (b) and (c) are studied. A.

539.11

8738. IMPURITY–VACANCY INTERACTION IN A METAL.
L.C.R.Alfred and N.H.March.
Phil. Mag. (Eighth Ser.), Vol. 2, 985-97 (Aug., 1957).

Using a generalization of the model first introduced by Mott for dealing with impurities in monovalent metals, the interaction between an impurity and a vacancy has been studied. Detailed computations have been carried out for the case of copper, with a divalent impurity and a vacancy at a separation of 5 atomic units. The interaction is attractive, the associated energy being calculated as 0.08(4) eV when exchange and correlation energies are neglected. Inclusion of these effects reduces the interaction energy to 0.03(3) eV. A previous calculation by Lazarus leads to a value of 0.045 eV for the case considered here, while a modification of the Lazarus expression proposed by the present writers gives 0.035 eV. Thus the present work tends to substantiate further the Lazarus theory of solute diffusion in metals. A.

539.11

8739. THE OVERHAUSER EFFECT IN SOLIDS. W.A.Little.
Proc. Phys. Soc. B, Vol. 70, Pt 8, 785-95 (Aug., 1957).

A theoretical treatment is given of the Overhauser effect in solids containing two or more different nuclear species. In a rigid lattice a decrease is predicted in the macroscopic magnetic moment of one nuclear species on saturating the spin system of the other. In a lattice executing internal motion the Overhauser effect is shown to be strongly dependent upon the value of the lattice correlation time. The usual assumption of the temperature dependence of this correlation time allows one to predict the variation of the Overhauser effect with temperature. The theoretical results are compared with experiment. Good agreement is obtained for the temperature dependence of the Overhauser effect in phosphonium iodide. Agreement in ammonium fluoborate could be obtained only on the assumption that the "internal" relaxation of the spins in the ammonium ion is small compared with the "external" relaxation processes. At low magnetic field strengths lithium fluoride exhibited the expected behaviour of the Overhauser effect in a rigid lattice. A.

539.11 : 548.736.1

8740. ON THE RELATION BETWEEN BOND HYBRIDS AND THE METALLIC STRUCTURES.
S.L.Altmann, C.A.Coulson and W.Hume-Rothery.
Proc. Roy. Soc. A, Vol. 240, 145-59 (May 21, 1957).

The failure of existing theories to account for the type of crystal structure of a given metal is emphasized. It is suggested that, particularly when the number of bonding electrons is high, the metallic bond has greater directional characteristics than are generally assumed, and that these can be related to the symmetries of known hybrid bonds. Hybrids involving both gerade and ungerade orbitals (e.g. sp^3) are not centrosymmetrical, and give rise to electron clouds biased on one side of the atom, which are thus strongly directional and suitable for strong bonding. Hybrids derived from gerade orbitals are centrosymmetrical, so that the binding electron has an equal chance of finding itself on opposite sides of the atom. This bonding is weaker, but the number of ligands is doubled; thus the four tetrahedral directions of the sd^3 hybrid can give bonding to eight neighbours, as with an atom in a body-centred cubic structure. These ideas are applied to the face-centred cubic, body-centred cubic and close-packed hexagonal structures of the transition metals, and it is shown that the hybrids suggested by the crystal structures can be correlated with the known electron characteristics of these metals. An explanation of the difference between the crystal structures of the elements of groups VIIA and VIIIA of the first and those of the later transition series is advanced, and the general tendency for transition elements to be more soluble in the body-centred cubic than in the close-packed hexagonal modification of titanium and zirconium is explained. A.

539.11

8741. ELECTRONIC ENERGY BANDS IN MODEL THREE DIMENSIONAL LATTICES. A.Raychaudhuri.
Z. Phys., Vol. 148, No. 4, 435-42 (1957).

Presents a discussion of the energy bands in a three dimensional lattice in which the potential is assumed to have a constant nonvanishing value in a spherical region round each nucleus and vanishes in the interspace. Introducing some simplifying approximations, a relation between the electronic energy and the wave vector is obtained. The case of an ordered diatomic alloy is next considered and the splitting of the bands for such a lattice is clearly brought out. The significance of this result in the theory of antiferromagnetism is pointed out. Lastly it is noted that for this model of an alloy, the theorem enunciated by Saxon and Hutner is valid. A.

MOLECULES 539.13

539.13 : 539.181

8742. SCATTERING OF HIGH VELOCITY NEUTRAL PARTICLES. X. He–N_2; A–N_2. THE N_2–N_2 INTERACTION.
I.Amdur, E.A.Mason and J.E.Jordan.
J. chem. Phys., Vol. 27, No. 2, 527-31 (Aug., 1957).

For Pt IX, see Abstr. 760 (1957). Total collision cross-sections have been measured for helium atoms with energies between 500 and 2100 eV, and for argon atoms with the same energies, scattered in room temperature nitrogen. The results have been analysed to

obtain the average potential between a helium atom and a nitrogen molecule, $\langle V(r)\rangle_{Av} = 1.19 \times 10^{-10}/r^{7.06}$ ergs, for r between 1.79 A and 2.29 A, and the average potential between an argon atom and a nitrogen molecule, $\langle V(r)\rangle_{Av} = 1.21 \times 10^{-9}/r^{7.78}$ ergs, for r between 2.28 A and 2.83 A. A procedure which takes into account the non-coincidence of the centre of mass and the centres of force in the N_2 molecule has been developed for expressing these average atom–molecule interactions as functions of the atom–atom potential between the beam particle and either of the nitrogen atoms. These interatomic potentials have been combined with potentials previously determined for He–He and A–A to obtain a hypothetical potential between two nitrogen atoms in different N_2 molecules. The following average intermolecular potential for the N_2–N_2 system has been obtained by averaging such N–N interactions over all mutual orientations of the two N_2 molecules: $\langle V(r)\rangle_{Av} = 9.54 \times 10^{-10}/r^{7.27}$ ergs, for r between 2.43 A and 3.07 A. This N_2–N_2 potential is consistent with one valid at larger separation distances, which has been derived from measurements on gaseous viscosity at high temperatures. A.

539.13

8743. INTERACTIONS BETWEEN PERMANENT MULTIPOLE MOMENTS. L.Jansen.
Physica, Vol. 23, No. 7, 599-604 (July, 1957).

A vector-tensor notation for interactions between arbitrary charge distributions, at large distance from each other, is developed which leads to a simple expression for the expectation value of the Coulomb potential. It is proven that for cylindrically symmetric charge distributions the interactions between permanent moments of any order may be replaced by those between linear distributions of charge along the axes of cylindrical symmetry. A.

539.132

8744. FORCE CONSTANTS FOR UNLIKE MOLECULES ON EXP-SIX MODEL FROM THERMAL DIFFUSION.
B.N.Srivastava and K.P.Srivastava.
Physica, Vol. 23, No. 2, 103-17 (Feb., 1957).

The potential parameters for the unlike pairs of molecules Ne–A, Ne–Kr and A–N_2 have been determined for the exp-six model from the temperature dependence of thermal diffusion of these gas mixtures following the method developed earlier by Srivastava and Madan. The method of translations given by Mason and Rice was employed to determine the parameters α_{12} and ϵ_{12} by successive approximations, taking into account also the small temperature variation of the "g" factor and utilizing Kihara's first approximation formula. The parameter $(r_m)_{12}$ was found by substituting the approximate values of α_{12} and ϵ_{12} in the theoretical expressions for binary viscosity, inter-diffusion or thermal diffusion and utilizing the experimental data. The values of the unlike parameters α_{12}, ϵ_{12} and $(r_m)_{12}$ thus obtained were utilized to calculate the thermal diffusion factor at different temperatures, using Kihara's expression, and the results obtained were found to agree with the experimental data within the limits of experimental error, thereby confirming the values of the potential parameters. The results show that $(r_m)_{12}$ could be calculated from the absolute value of the thermal diffusion factor if Kihara's first approximation formula is utilized and correct values of α_{12} and ϵ_{12} substituted. The combination rules for unlike potential parameters given by Mason and Rice have been found to be inadequate and simpler combination rules have been suggested. A.

539.132

8745. THOMAS–FERMI MODEL FOR DIATOMIC HYDRIDES.
Y.P.Varshni.
Ann. Phys. (Leipzig), Vol. 19, No. 3-5, 233-41 (1956).

Assuming a simple model, force constants of diatomic hydrides have been calculated by Thomas–Fermi method. Though the calculated values are usually lower than the observed ones, the trend of variation of force constants in the Periodic Table is well reproduced. A.

539.132

8746. FUNDAMENTAL OF $N^{15}O$. W.H.Fletcher and G.M.Begun.
J. chem. Phys., Vol. 27, No. 2, 579-82 (Aug., 1957).

The fundamental vibration–rotation band of $N^{15}O$ has been examined with a grating spectrometer. The molecular constants obtained are in good agreement with existing data and the isotope relations. A.

539.132

8747. ON THE USE OF HUTCHISSON'S AND MANNEBACK'S MATHEMATICAL TECHNIQUES FOR THE DERIVATION OF VIBRATIONAL TRANSITION PROBABILITIES.
N.R.Tawde, B.S.Patil, N.Sreedhara Murthy and M.R.Katti.
Physica, Vol. 23, No. 2, 154-6 (Feb., 1957).

Referring to the results of vibrational transition probabilities on the OH ($A^2\Sigma^+ \rightarrow X^2\pi$) system by Manneback and Rahman, the claim of superiority made by the authors for the simplicity of Manneback's technique in relation to that of Hutchisso is critically examined. A

539.132

8748. SIMULTANEOUS VIBRATIONAL TRANSITIONS.
F.N.Hooge and J.A.A.Ketelaar.
Physica, Vol. 23, No. 5, 423-35 (May, 1957).

A quantum mechanical treatment is given of two interacting harmonic oscillators with the result that simultaneous transitions are shown to be possible. The intensity ratio of difference and sum transitions is derived:

$$I_-/I_+ = \frac{\nu_A - \nu_B}{\nu_A \quad \nu_B} \exp(-h\nu_B/kT)$$

in good accordance with experiment. Cubic terms in the potential energy are shown to have no appreciable influence. Selection rules are given. The influence of temperature derived is compared with experimental results. In the infrared absorption spectra of some mixtures bands are found at frequencies, which are the sum or the difference of a vibration frequency of one compound and a vibration frequency of the other compound in the mixture. Two colliding molecules absorb together one quantum and undergo simultaneously a vibrational transition. A theoretical treatment of these simultaneous transitions is given. A

539.1

8749. ON THE ELECTRONIC STRUCTURE OF THE BH MOLECULE. K.Ohno.
J. chem. Phys., Vol. 26, No. 6, 1754-5 (June, 1957).

A non-empirical calculation of the dissociation and excitation energies of the BH molecule is discussed. G.I.W.Llewel

539.13

8750. ELECTRONIC STATES OF DIATOMIC MOLECULES: THE LITHIUM MOLECULE. R.Fieschi.
Nuovo Cimento, Vol. 6, No. 1, 197-203 (July, 1957).

The method of "atoms in molecules" is applied to the calculation of the electronic energy levels of Li_2. The molecule is treated as a two-electron system; only configurations involving 2sσ, 2pσ and 2pπ molecular orbitals are considered. The results for the $^1\Sigma_u^+ - {}^1\Sigma_g^+$ transition are in reasonable agreement with the experimental results; this is not the case for the $^1\Pi_u - {}^1\Sigma_g^+$ interaction, probably owing to the inaccurate value of the "core" interaction in the two-electron molecular model. The purely theoretic LCAO MO results obtained taking into account configuration interaction are in disagreement with the experimental results in both cases. Although no decisive conclusion regarding the accuracy of the method can be drawn, since inclusion of 1s-electrons will possibly influence the energy spacings, one does not find the disappointing results obtained by others in a similar calculation.

539.1

8751. THE TRANSVERSE RELAXATION TIME OF PARAMAGNETIC ELECTRON RESONANCE IN DIPHENYLPICRYLHYDRAZ BETWEEN 15° K AND 300° K.
L.van Gerven, A.van Itterbeek and E. de Wolf.
J. Phys. Radium, Vol. 18, No. 7, 417-21 (July, 1957). In French.

The line width δ_0 of two different samples of diphenylpicrylhydrazyl has been measured between 1.5° K and 300° K. These measurements were made in the first place in order to determine the dependence of the transverse relaxation time on temperature, and secondly to investigate the causes of the differences between the values of δ_0 given by different authors. The spectrometer, operating at 18 Mc/s, is very simple but has a high degree of fidelity. Special precautions were taken in order to avoid distort of the absorption curve. The lines are Lorentz shaped at all but the lowest temperatures, where the effects of the "modified Bloc theories" appear. The values of δ_0 are in good agreement with th of Singer and Spencer and those of Garstens, Singer and Ryan. T are smaller than all the other values already published, of which survey is given.

539.132

8752. PURE QUADRUPOLE SPECTRUM OF CYANURIC CHLORIDE. H.Negita and S.Satou.
J. chem. Phys., Vol. 27, No. 2, 602-3 (Aug., 1957).

539.132

8753. NUCLEAR SPIN RELAXATION IN HYDROGEN. I. THE GAS. M.Bloom.
Physica, Vol. 23, No. 3, 237-47 (March, 1957).

The proton spin–lattice relaxation time t_1 has been measured in H_2 gas as a function of (a) density at 20.4°K, (b) ortho–para concentration at 20.4°K, (c) percentage H_2 molecules in H_2–He mixtures at 20.4°K, (d) density of the saturated vapour between 20.4°K and 15.5°K. The results are interpreted in terms of the relaxation mechanism originally proposed by Schwinger and provide a measurement of the cross-section for collisions which cause the ortho-H_2 molecules to reorient. The average cross-section for collisions which produce reorientations is three times as high for ortho–ortho collisions as for ortho–para collisions at 20.4°K. The effective cross-section rises rapidly with decreasing temperature. It is suggested that t_1 measurements will enable a detailed study of the anisotropic part of the H_2–H_2 and H_2–HD interactions to be made. The proton t_1 in HD is much longer than that of the protons in H_2 because the ground state of HD is J = 0 where the Schwinger mechanism is inoperative. One can infer the mean time spent by HD molecules in the J = 1 state from t_1 measurements. A.

539.132

8754. NUCLEAR SPIN RELAXATION IN HYDROGEN. II. THE LIQUID. M.Bloom.
Physica, Vol. 23, No. 5, 378-88 (May, 1957).

The proton spin relaxation time t_1 for H_2 liquid has been measured as a function of temperature and ortho–para concentration. For normal H_2, t_1 is found to be 0.18 second at 20.4°K and is found to increase with decreasing temperature and decrease with decreasing ortho-H_2 concentrations. Calculations show that the translational motion of the H_2 molecules contributes negligibly to t_1, and that the usual model used to explain the contribution to t_1 from reorientations of the molecules fails to explain the observed temperature and ortho–para concentrations dependences. The results are shown to be closely related to the behaviour of t_1 in H_2 gas. Measurements on HD liquid show a t_1 of about 35 second. This is interpreted as being due to the translational motion of the molecules relative to one another, an argument being presented to show that the rotational contribution to t_1 is negligible for HD at the temperatures studied. A.

539.132

8755. CALCULATION ON THE ELECTRONIC STATES OF THE FORMALDEHYDE MOLECULE BY A SEMIEMPIRICAL MOLECULAR ORBITAL METHOD. T.Anno and A.Sadô.
J. chem. Phys., Vol. 26, No. 6, 1759-60 (June, 1957).

The semiempirical M.O. method of Pariser and Parr (Abstr. 3508, 5636/1953) is extended to include the non-bonding n electrons as well as π electrons in conjugated hydrocarbons and the heteromolecules. The approximation is verified by consideration of the formaldehyde molecule and results consistent with experimental results obtained. G.I.W.Llewelyn

539.132

8756. S.C.F. L.C.A.O. M.O. STUDY OF Li_2. J.E.Faulkner.
J. chem. Phys., Vol. 27, No. 2, 369-73 (Aug., 1957).

An LCAO molecular orbital calculation using the full six-electron Hamiltonian has been performed on Li_2 at a nuclear separation equal to the experimental internuclear distance. The molecular wave-function consisted of one antisymmetrized product made up of molecular orbitals formed as the best linear combinations of Slater 1s, 2s, and $2p_\sigma$ atomic orbitals. The orbital exponents for these atomic orbitals were respectively 2.69, 0.64, and 0.53 as determined by variational calculation on the lithium atom. In computing the molecular dissociation energy, the energy of two separated lithium atoms was taken to be that obtained by this variational calculation. The computed dissociation energy was found to be 0.33 eV compared with the experimental value of 1.05 (where a slight correction for zero-point energy has been made). The ratio of the computed molecular ground-state energy to the experimental is 0.9902 while the difference of these quantities is 4.00 eV. Certain other molecular constants are calculated and compared with available experimental data. A.

539.132

8757. APPROXIMATE DIATOMIC ORBITALS FOR H_2^+.
M.d'Hooghe and A.Rahman.
Physica, Vol. 23, No. 1, 26-30 (Jan., 1957).

Approximate wave-functions for H_2^+ have been constructed for the stationary states $1s\sigma$, $2s\sigma$, $3s\sigma$ and $2p\pi$ (only for one internuclear distance = 2 A) using functions of the confocal elliptical system of coordinates; this can be appropriately called the method of diatomic orbitals. The separability of the Schrödinger equation is used in constructing the approximate function which is thus in the form of a product of functions of one coordinate at a time; the functions thus constructed are much simpler to handle than the rigorous infinite series solutions and they give highly accurate values for the energy of the corresponding state. A.

539.132

8758. CONFIGURATION INTERACTION IN GROUND STATE OF H_2 MOLECULE. A.Rahman.
Physica, Vol. 23, No. 1, 31-6 (Jan., 1957).

The energy of the ground state of the hydrogen molecule has been computed using two-centre one electron molecular orbitals to build the wave-function. These two-centre orbitals are similar to the functions which give very accurate energy values for the H_2^+ ion. The present computation is similar to the one making use of products of one electron hydrogen-like configurations to build wave-functions for atomic helium. The computations show that for the hydrogen molecule satisfactory results are obtained in the neighbourhood of the equilibrium internuclear distance if H_2^+-like configurations are used to construct the wave-function. The calculated values for the energy of the hydrogen molecule approach the values calculated by James and Coolidge in 1933 better than any other computation reported so far; the configurations used are $(1s\sigma)^2$, $(2p\sigma)^2$ and $(2p\pi)^2$; with the addition of configurations of the type $(3d\sigma)^2$ and others much better results can be expected. A.

539.132

8759. ELECTRONIC ABSORPTION SPECTRA OF HETEROCYCLIC SYSTEMS. I. A COMPARISON OF THEORETICAL METHODS: PYRIDINE AND PYRAZINE. R.McWeeny.
Proc. Phys. Soc. A, Vol. 70, Pt 8, 593-604 (Aug., 1957).

This work is concerned with the application of recent theoretical methods in elucidating the spectra of heterocyclic systems. It is now generally accepted that a satisfactory picture of the first few excited states can only be obtained by admitting limited configuration interaction. But this picture is also dependent upon the precise choice of orbitals — which, in a heterocyclic molecule, may range from Hückel molecular orbitals of the parent hydrocarbon to self-consistent orbitals of the substituted system and scarcely any information is available concerning the relative merits of different choices. In the present paper (Pt I) general methods are summarized, seven different choices of orbitals are suggested and discussed, and careful numerical comparisons are made in applications to pyridine and pyrazine. Useful conclusions emerge, in the light of which it is possible to consider more complicated systems. Such developments are to be taken up in a companion paper by Peacock (Pt II). A.

539.132

8760. A PERTURBATION CALCULATION OF PROPERTIES OF THE $2p\pi$ STATE OF HeH^{2+}. A.Dalgarno and A.L.Stewart.
Proc. Roy. Soc. A, Vol. 240, 274-83 (May 21, 1957).

A perturbation calculation, valid in the limit of large separations, of various properties of the $2p\pi$ state of HeH^{2+} is carried out. The total energy and the kinetic and potential energies are calculated to the fifth order, the dipole moment to the third order and the quadrupole moments to the second order, and the results compared with those obtained using exact and variationally determined two-centre wave-functions. Some results are also given for the $2p\pi_u$ and $3d\pi_g$ states of H_2^+ and the influence of nuclear symmetry at large separations is briefly discussed. A.

539.132 : 539.153

8761. DIPOLE AND QUADRUPOLE POLARIZABILITIES OF ATOMS AND MOLECULES. A.Dalgarno and J.T.Lewis.
Proc. Roy. Soc. A, Vol. 240, 284-92 (May 21, 1957).

Simple semi-empirical formulae are suggested for estimating dipole and quadrupole polarizabilities of atoms and diatomic molecules, and their accuracy is demonstrated by a comparison with

available experimental data and theoretical predictions. Additional comparison data are provided by accurate calculation of the parallel dipole polariability of the ground state of the hydrogen molecular ion. A.

539.133 : 548.736.3

MOLECULAR STRUCTURE OF BORON CHLORIDES AND HYDRIDES. See Abstr. 8293-6

539.133 : 535.343

8762. STRUCTURE OF THE METHYLAMINE MOLECULE. I. MICROWAVE SPECTRUM OF CD_3ND_2. D.R.Lide, Jr.
J. chem. Phys., Vol. 27, No. 2, 343-52 (Aug., 1957).

The spectrum of CD_3ND_2 has been investigated in the 24 000-36 000 Mc/s region and about thirty lines have been assigned. The rotational spectrum exhibits a fine structure as a result of internal rotation and inversion. An approximate treatment of these internal motions is formulated and shown to give an excellent fit of the observed spectrum. A treatment of Stark effects and nuclear quadrupole interactions is developed and applied to the CD_3ND_2 spectrum. The relation to the CH_3NH_2 spectrum is discussed. Molecular constants of CD_3ND_2 determined from the spectral analysis are: torsional barrier height $H = 684.7 \pm 2\ cm^{-1}$; dipole moment components $\mu_a = 0.265$ D, $\mu_c = 1.299$ D, total $\mu = 1.326 \pm 0.015$ D; N^{14} quadrupole coupling constants $\chi_{aa} = 2.35$ Mc/s, $\chi_{bb} = 2.12$ Mc/s, $\chi_{cc} = -4.47$ Mc/s. Structural parameters calculated from data on CD_3ND_2 and CH_3NH_2 are: $r_{CH} = 1.093$ A (assumed), $\angle HCH = 109^\circ 28'$ (assumed), $r_{CN} = 1.474$ A, $r_{NH} = 1.011$ A, $\angle HNH = 105^\circ 52'$, $\angle CNH = 112^\circ 3'$; the nitrogen atom is located 0.091 A from the CH_3 symmetry axis. A.

539.133 : 535.343

8763. STRUCTURE OF THE METHYLAMINE MOLECULE. II. THEORY OF INTERNAL MOTIONS AND APPLICATION TO CD_3ND_2. D.Kivelson and D.R.Lide, Jr.
J. chem. Phys., Vol. 27, No. 2, 353-60 (Aug., 1957).

A general theory is developed for the two low-frequency internal motions which influence the microwave spectrum of methylamine. The interactions of the overall and internal rotations with the inversion motion are treated quantum-mechanically for the case where the potential barriers to inversion and internal rotation are high. The theory justifies the method of analysis of the CD_3ND_2 spectrum which was given in Pt I. An expression is obtained for the empirical inversion parameters F_{K_T} defined in Pt I, and is shown to give an excellent fit of the experimental results for CD_3ND_2. The inversion splitting constant obtained from this calculation is 2246.0 ± 5 Mc/s. The significance of this constant and of the other molecular parameters which enter the theory is discussed. A.

ATOMS. NUCLEUS. ISOTOPES 539.15

539.152.1

8764. COMPOUND NUCLEAR THEORY AND THE OPTICAL MODEL. J.Bowcock.
Proc. Phys. Soc. A, Vol. 70, Pt 9, 708 (Sept., 1957).
Corrigendum. See Abstr. 7287 (1957).

539.152.1

8765. VELOCITY-DEPENDENT NUCLEAR INTERACTION. W.E.Frahn and R.H.Lemmer.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1564-72 (June, 1957).

The single particle wave-equation describing the motion of nucleons in nuclei, as derived from the nuclear many-body problem, is of a non-local form in coordinate space. It is shown, that in the effective mass approximation, this equation reduces to a velocity-dependent Schrödinger equation, which contains a spatially variable effective nucleon mass in a properly symmetrized kinetic energy operator. The eigenvalue problem is treated for the special case of the infinite harmonic oscillator potential as the local part of the interaction. A.

539.152.1 : 539.172.4

8766. ASYMMETRIC EQUILIBRIUM SHAPES IN THE LIQUID DROP MODEL. U.L.Businaro and S.Gallone.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 315-17 (Jan., 1957).

The formulae derived in earlier papers (Abstr. 9105 /1955) have been applied to the problem of asymmetric fission. Deformations of the type P_2 and P_3 are considered and conditions for asymmetric fission derived. L.L.Green

539.152.1

8767. PERTURBATION APPROACH TO THE FERMI GAS MODEL OF HEAVY NUCLEI. N.M.Hugenholtz.
Physica, Vol. 23, No. 6, 533-45 (June, 1957).

The general perturbation method presented in Abstr. 8429 (1957) is applied to a study of some aspects of the Fermi gas model of nuclear matter. The two extreme cases of very low and very high particle density are investigated. It is shown that the theory recently developed by Brueckner can be considered as an improved low density approximation. The validity of some other approximations made in the Brueckner theory, involving the energy denominators in intermediate states are briefly discussed. The study of the case of high density reveals the interesting fact that, contrary to indications presented by Swiatecki and Bethe, the convergence of the perturbation expansion gets worse with increasing density, while in that case the Brueckner approximation becomes extremely poor. It is furthermore shown that a slow nucleon, travelling through nuclear matter, can be considered as being in a metastable state and an exact expression for the inverse life-time of such a state is given; this quantity must be identified with the imaginary part of the potential in the optical model. A.

539.152.1

8768. WEAK COLLECTIVE EFFECTS IN THE NUCLEAR SHELL MODEL. R.D.Amado and R.J.Blin-Stoyle.
Proc. Phys. Soc. A, Vol. 70, Pt 7, 532-5 (July, 1957).

A configuration mixing approach with closure is applied to nuclei near the lead closed shell and gives values consistent with experimental results for the edge thickness (t = 0.3) and mean excitation energies. For O^{17} the predicted ground state quadrupole moment agrees with a new experimental value (unpublished) of -0.027 ± 0.004 barn. E.J.Burge

539.152.1

8769. EFFECTIVE NUCLEAR POTENTIALS. W.E.Frahn and R.H.Lemmer.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 523-5 (Feb., 1957).

Effective nuclear potentials are calculated and the reduced nuclear mass obtained for various nucleon–nucleon potentials. L.L.Green

539.152.1

8770. TABULATION OF THE WIGNER 9j COEFFICIENTS. J.W.Stephenson and K.Smith.
Proc. Phys. Soc. A, Vol. 70, Pt 8, 571-2 (Aug., 1957).

The tabulation of the Wigner 9j coefficient $\begin{pmatrix} a & b & e \\ c & d & f \\ g & h & k \end{pmatrix}$ is described. The calculation was performed on an electronic digital computing machine. The range of the parameters tabulated is $\frac{1}{2} \le a, b, c, d \le 7/2;\ 0 \le e, f, g, h, k \le 7$.

539.152.1 : 532

8771. REVERSIBILITY AND IRREVERSIBILITY IN NUCLEAR RESONANCE. I. THEORY OF NUCLEAR RELAXATION IN LIQUIDS. J.Seiden.
J. Phys. Radium, Vol. 18, No. 3, 173-92 (March, 1957). In French

Starting with the Schrödinger equation reversible relative to time, the author demonstrates the irreversibility of the evolution of a system of nuclear spins in thermal contact with a heat reserv The spin–spin interaction is supposed to be sufficiently weak for the behaviour of each spin j to be considered as independent of the behaviour of its neighbours. The heat reservoir is considered as a classical system; this is justified because the energies are $\ll kT$ The interaction energy $\sum_j V^{(j)}(t)$ of the spins with the heat reservo is considered as a random function of time; this energy causes transitions to take place between the stationary states of $K = -\gamma\hbar H_0 \sum_j I_j$, the energy of the spins in the magnetic field H_0.

The spins must obey certain conditions for relaxation to take plac sufficient conditions are that there are an infinity of spins, and th the wave-functions $\Psi^{(j)}(0)$ of the spins at the intial time form a compact ensemble in the space of the functions $\Psi^{(j)}$. The theory relaxation is based on a development of the evolution operator in powers of the perturbation $V^{(j)}(t)$. A relaxation operator $\sigma(t)$ is introduced, similar to the distribution functions of Boltzmann. It is necessary to calculate $\sigma(t)$ to all orders in $V^{(j)}$ in order to use the hypothesis of compactness of the $\Psi^{(j)}(0)$ at the initial time on

This rigorous calculation shows that the only processes contributing to the relaxation are those of second order in $V^{(j)}$. The perturbation $V^{(j)}$ acts twice in time intervals of the size of τ_c, the correlation time of $V^{(c)}(t)$. A system of differential equations (Boltzmann equations) which must be obeyed by $\sigma(t)$ is formed; these equations give a complete specification of the relaxation process. There are no statistical arguments, the demonstration being accomplished only with the help of the laws of quantum mechanics. The theory can be applied to nuclear magnetic resonance in liquids and gases and, with some restrictions, to nuclear resonance in molecular crystals and metals. It is shown that the determination of the absorption spectrum is equivalent to the problem of the relaxation of a quantity with selection rule $\Delta m = \pm 1$. A.

539.152.1 : 537.533.74

8772. INELASTIC SCATTERING OF ELECTRONS BY NUCLEI. L.J.Tassie.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1497-509 (June, 1957).

It is shown that the variation with energy of the differential cross-section for the scattering of high-energy electrons by nuclei depends on whether the nuclear transition occurs with $\Delta M = 0$ or with $\Delta M = \pm 1$, where M is the component of the nuclear spin in the direction of the vector change of momentum of the scattered electron. The electron excitation of $\Delta M = 0$ transitions is then considered using the independent particle model of the nucleus and comparison is made with the experimental results of Fregeau for C^{12}. A.

539.152.1

8773. THE EXCITATION OF A 2.79 MeV LEVEL IN ^{19}F BY INELASTIC NEUTRON SCATTERING. J.M.Freeman.
Phil. Mag. (Eighth Ser.), Vol. 2, 628-34 (May, 1957).

Gamma-rays of energy 2.594 ± 0.015 MeV have been observed following the inelastic scattering in F^{19} of neutrons in the energy range 3.2 to 3.7 MeV. They are attributed to a level at 2.791 ± 0.015 MeV which decays principally by a transition to the second excited state at 197 keV. The cross-section for production of these gamma-rays has been measured as a function of neutron energy and the result compared with the predictions of the Hauser–Feshbach model for different values of the spin of the level. It is concluded tentatively that the spin of the 2.79 MeV level is either 9/2 or 7/2. A.

539.152.1

8774. ON THE COLLECTIVE CHARACTER OF THE FIRST EXCITED 0^+ STATE OF O^{16}. J.Touchard.
C.R. Acad. Sci.(Paris), Vol. 244, No. 20, 2499-502 (May 13, 1957). In French.

The calculations of Ferrel and Visscher (Abstr. 4579/1956) on the first excited 0^+ state of O^{16} have been modified by using a constrained slowly varying potential. It is found that it is still difficult to reduce the energy of the excited state to the observed value, but if the experimental value of this energy is used improved agreement with the decay rate can be obtained. L.L.Green

539.152.1

8775. NUCLEAR LEVELS AND SHELL STRUCTURE. K.Bleuler and C.Terreaux.
Helv. phys. Acta, Vol. 30, No. 2-3, 183-205 (1957).

The experimental results concerning binding energies and levels schemes from all heavier odd neutron nuclei ($A > 30$) are studied. A new graphical method is introduced in order to obtain a comprehensive survey of these values throughout the periodic table by means of a system of curves. With the help of this geometrical representation a detailed comparison with the corresponding results from the shell model is made. There is a striking agreement in a large part of the periodic table. Typical deviations are found in the domain of large level density of the spherical shell structure (corresponding to the region of deformed nuclei). From this comparison it is possible to determine a phenomenological expression for the spin orbit coupling term. This interaction agrees with the results obtained from an analysis of the scattering of polarized protons. It is then shown that the same coupling law also holds in the region of light nuclei. Some preliminary considerations about the pseudoscalar meson field in relation to this large spin orbit interaction are given. A.

539.152.1

8776. LEVEL SCHEME OF Re^{185}. N.Marty and M.Vergnes.
J. Phys. Radium, Vol. 18, No. 4, 233-8 (April, 1957). In French.

The level scheme of Re^{185} formed by electron capture from Os^{185} is studied. From the conversion-electron spectrum, the γ-rays and $\gamma\gamma$-coincidences, the existence of γ-rays of 125, 592 are 718 keV and confirmed. From their conversion coefficients the 646, 718 and 877 keV γ-rays are stated to be respectively $E_2(+M_1)$, M_1 and E_2 transitions. Levels at 0, 125, 646, 718, 877 keV are given the assignments (5/2 5/2 +) (5/2 7/2 +) (3/2 3/2 +) (3/2 5/2 +) (1/2 1/2 +). A.

539.152.1

8777. STUDY OF THE 6.89 MeV LEVEL OF B^{10}. G.R.Bishop and J.C.Bizot.
J. Phys. Radium, Vol. 18, No. 7, 434-40 (July, 1957). In French.

Angular distribution and correlation measurements on γ-rays emitted from the 6.89 MeV level of B^{10} have been made. They are consistent with spin 1 for this level, but not with spin 2. Interpretation of the forbidden transitions to the levels 2.15 and 0.72 MeV energy by a strong contamination of T = 1 could then not be ruled out. Another forbidden transition (6.89 MeV to 3.58 MeV) has been observed. A.

539.152.1

8778. ON THE 7.7 MeV LEVEL OF CARBON 12. A.Hossain and D.J.Prowse.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 973-6 (April, 1957).

The analysis of the α-particle spectrum from the reaction $N^{14}(d,\alpha)C^{12}$ at a bombarding energy of 20 MeV and of the inelastically scattered proton spectrum from C^{12} at an energy of 9.5 MeV has revealed the presence of the 7.7 MeV level in C^{12}. Approximate values are given for the cross-sections leading to the formation of this level in both reactions. A.

539.152.1

8779. THE 4.77 MeV LEVEL IN BORON 10. H.Warhanek.
Phil. Mag. (Eighth Ser.), Vol. 2, 1085-8 (Sept., 1957).

The angular distribution of the γ-rays in $Li^6(\alpha,\gamma)B^{10}$ has been measured for the 500 keV resonance. Spin and parity of the 4.77 MeV level in B^{10} are 2+ or 3+. The intensity of the direct transition to the ground state is less than 3% of the intensity of the 4.05 MeV γ transition. The width of the level $\omega\Gamma_\alpha\Gamma_\gamma/\Gamma_\alpha + \Gamma_\gamma$ is about 5×10^{-2} eV. The 4.05 MeV E2 transition is at least twice as strong as one would expect from the Weisskopf formula. A.

539.152.1

8780. LOW-LYING 0^+-STATES IN NUCLEI. A.S.Reiner.
Physica, Vol. 23, No. 4, 338-48 (April, 1957).

Low-lying 0^+ states in even-even nuclei are discussed and correlated with their shell structure. The merits of the hypothesis of pair promotion as a possible explanation for their occurrence are investigated and checked for the Ge^{72} case. If this hypothesis were true, the rate of $0^+ \rightarrow 0^+$ transitions would be a sensitive measure of the residual particle interactions. The conclusion can be drawn that only a fraction of the internucleon potential is active in the transition between the nucleons in the excited and ground states. The investigation of nuclei where 0^+ states might be expected could lead to better founded conclusions. A.

539.152.1

8781. THE ISOMER Pd^{111}*. B.G.Dzantiev, V.N.Levkovskiĭ, A.D.Malievskiĭ and M.V.Serdobov.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 4, 773-6 (1957). In Russian.

Isomers of Pd^{111} formed in the reactions $Cd(n,\alpha)$ and $Pd(n,\gamma)$ are separated chemically. From the resultant activity, the isomer Pd^{111}* (T = 5.5 hr) is established. The ratio of production of Pd^{111} to that of Pd^{111}* in bombardment of metallic Pd by neutrons was ~ 22. G.E.Brown

539.152.1

8782. VALUE OF THE SPIN OF THE Fe^{57} NUCLEUS. N.S.Garif'yanov, M.M.Zaripov and B.M.Kozyrev.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 6, 1243 (1957). In Russian.

The spin was measured in an enriched sample by paramagnetic resonance. The spin of 1/2 was assigned. The hyperfine structure constant is of the order of 10 gauss. G.E.Brown

539.152.2

8783. SPIN OF U^{235} AND RATIOS OF THE NUCLEAR MOMENTS OF U^{235} AND U^{233}. J.Blaise, S.Gerstenkorn and M.Louvegnies.
J. Phys. Radium, Vol. 18, No. 5, 318-19 (May, 1957). In French.

The hyperfine structure of the line λ 5915 A of U I, $(5f^3\,6d\,7s^2\,5L_6 - 169_7)$ has been investigated by means of a recording photoelectric Fabry–Perot spectrometer for a specimen enriched to 21% of U^{235}. The relative intensities of two completely resolved

components of the flag pattern show that the spin of U^{235} is I = 7/2. From the hyperfine structure of U^{233}, measured for the same line by Korostyleva, Striganov and Iashin, are derived the ratios:

$$\mu_{235}/\mu_{233} = -0.65 \text{ and } Q_{235}/Q_{233} = +1.4_3.$$ A.

539.152.2

8784. NUCLEAR ALIGNMENT OF YTTERBIUM 175.
M.A.Grace, C.E.Johnson, R.G.Scurlock and R.T.Taylor.
Phil. Mag. (Eighth Ser.), Vol. 2, 1079-84 (Sept., 1957).

Nuclear alignment of Yb^{175} has been obtained by cooling a single crystal of ytterbium ethyl sulphate to about 0.014° K, and was detected by observing the anisotropic angular distributions of the two most energetic γ-rays. A relationship between the mixing ratios δ(M2/E1) for these γ-rays is obtained. Gamma–gamma angular correlation measurements for the 282 and the 114 keV γ-rays show sensibly the same value for the correlation coefficient A_2 of $+0.205 \pm 0.015$ for solid and liquid sources containing Yb^{175}. Using $|\delta| = 0.17 \pm 0.03$ for the 282 keV γ-ray determined from the angular correlation measurements the mixing ratio for the 396 keV γ-ray is found to be $+0.10 \pm 0.03$. The nuclear moment of Yb^{175} is 0.15 ± 0.04. A.

539.152.2

8785. MEASUREMENT OF THE SPIN AND GYROMAGNETIC RATIO OF As^{76}. F.M.Pipkin and J.W.Culvahouse.
Phys. Rev., Vol. 106, No. 5, 1102-4 (June 1, 1957).

Nuclear alignment of 27 hr As^{76} was produced by saturating an electron resonance in a Si crystal containing 5×10^{10} As^{76} atoms. The γ-ray anisotropy was used to detect changes in the degree of alignment induced by the application of further r.f. fields. It is concluded that the nuclear spin is 2, the h.f.s. interaction -93.6 ± 0.2 Mc/s and the nuclear g-factor -0.453 ± 0.002.
M.A.Grace

539.153

8786. ON A THEOREM ON THE SUM OF OSCILLATOR STRENGTHS FOR ALKALI METALS. I.B.Bersuker.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 5, 1017-19 (1957). In Russian.

V.A.Fock's values for the sum of oscillator strengths are recalculated and corrected. The new values are: 1.248 for Na, 1.269 for K, and 1.453 for Ca^+. S.Chomet

539.153

8787. ENERGY LEVELS IN RARE-EARTH IONS.
J.P.Elliott, B.R.Judd and W.A.Runciman.
Proc. Roy. Soc. A, Vol. 240, 509-23 (July 16, 1957).

The tensor-operator and group-theoretical methods of Racah are used to examine the following contributions to the Hamiltonian of a rare-earth ion: (a) the Coulomb interaction between the electrons, (b) the spin–orbit coupling of the electrons, and (c) the term arising from the influence of an external electrostatic field such as occurs when the rare-earth ion is situated in a crystal lattice. With regard to (a), the positions of all the terms of the configurations f^2, f^3 and f^4, as well as all the terms of other configurations f^n whose multiplicities are the highest or the highest but one, are tabulated on the basis of a hydrogenic 4f wave-function. The theory of (b) is developed, and the parameter λ defining the spin–orbit splitting of a term is given for all terms whose energies have been found. (c) is treated by similar techniques and the theory is related to the one at present in use. All the general methods are illustrated by examples. A.

539.153.4

8788. APPLICATION OF VARIATIONAL METHOD TO THE THOMAS–FERMI EQUATION. T.Ikebe and T.Kato.
J. Phys. Soc. Japan, Vol. 12, No. 2, 201-3 (Feb., 1957).

The variational method is applied to derive two inequalities giving rigorous upper and lower bounds for the initial slope $B_0 = -\varphi'(0)$ of the ordinary Thomas–Fermi function $\varphi(x)$, the solution of the non-linear equation $\varphi'' = x^{-1/2}\varphi^{3/2}$ with the boundary conditions $\varphi(0) = 1$, $\varphi(\infty) = 0$. Application of these formulae using simple trial functions leads to the estimate $1.5865 \leq B_0 \leq 1.5883$. A.

539.153.4 : 539.132

8789. ELECTRIC POLARIZABILITY OF ATOMS AND MOLECULES. J.A.Pople and P.Schofield.
Phil. Mag. (Eighth Ser.), Vol. 2, 591-8 (May, 1957).

Kirkwood's variation method for the calculation of the polarization of an atom or molecule in an external potential V(r), uses a wave-function

$$\Psi_0\left\{1 + \mu\sum_i V(r_i)\right\}$$

where Ψ_0 is the wave-function in the absence of the perturbation, and the summation is over the electrons. The energy is varied with respect to the parameter μ. In the paper an extension of the method is presented using a wave-function

$$\Psi_0\left\{1 + \sum_i u(r_i)\right\}$$

and varying the energy with respect to the function u(r). The optimum form is found to satisfy a second order differential equation which involves the single and pair electron density functions. This equation is solved numerically for argon, using the Hartree–Fock wave-function. The form of u turns out to be nearly quadratic, and shows that almost the whole of the induced dipole moment is due to the outer shell of the electrons. An estimate of the dipole–dipole energy is made using the function u, which in the case of argon gives good agreement with that estimated by other means. A.

539.153.4

8790. RELATIVISTIC SELF-CONSISTENT FIELD CALCULATION FOR MERCURY. D.F.Mayers.
Proc. Roy. Soc. A, Vol. 241, 93-109 (July 23, 1957).

Results, and some details of the methods used, are given of a solution of the relativistic self-consistent field equations for Hg^{2+} and neutral Hg. The results are compared with those of previous non-relativistic work, and the changes found to be substantial. A.

RADIOACTIVITY. α-, β- AND γ-RAYS 539.16

539.16.08

8791. DOSE MEASUREMENTS WITH PHOTOGRAPHIC FILMS ON A BETA-RAY NEEDLE. J.L.Haybittle and G.Mayr.
Experientia, Vol. 13, No. 4, 142 (April 15, 1957).

Graphs are given showing that the dose rates from beta-ray emitters, in the shape of tubes and needles, can be measured with a reasonable degree of accuracy with photographic films.
J.Hughes

539.16.08

8792. A GRAPHICAL METHOD FOR THE DETERMINATION OF HALF-LIVES. I.Kuščer, M.V.Mihailović and E.C.Park.
Phil. Mag. (Eighth Ser.), Vol. 2, 998-1002 (Aug., 1957).

The graphical determination of half-lives of radioactive isotopes can be made more accurate if the remaining number of counts, instead of the counting rate, is plotted as a function of time. This method has been used to measure the half-life of Si^{27}, for which the value 4.14 ± 0.03 seconds has been obtained. A.

539.16

8793. A GENERALIZATION OF THE MARSDEN–BARRATT LAW FOR TIME-CORRELATED RADIOACTIVE DECAY.
H.Lindeman and N.Rosen.
Physica, Vol. 23, No. 5, 436-40 (May, 1957).

A derivation is given of a probability law, which replaces the Marsden–Barratt law for the probability of a given time interval between two successive disintegrations in certain cases of time-correlated radioactive decay. A.

539.16

8794. LIFETIME AND DECAY SCHEME OF U^{235}.
E.Würger, K.P.Meyer and P.Huber.
Helv. phys. Acta, Vol. 30, No. 2-3, 157-82 (1957). In German.

The half-life of U^{235} with respect to alpha-decay was measured by comparison of its alpha-activity with the U^{238} and U^{234} activities of a source of natural uranium. As only one alpha-group of the U^{235} alpha-spectrum can be measured without interference from the other uranium isotopes, some knowledge of the U^{235} decay-scheme is necessary for the calculation of its half-life. Consequently the decay-scheme of U^{235}, proposed by Ghiorso, has been tested and verified in a scintillation-spectrometer by α–γ coincidences. Furthermore the conversion of the two γ-rays has been measured. The value of $6.84 \pm 0.15 \times 10^8$ years found for the half-life of U^{235} is in agreement with the value of $7.13 \pm 0.16 \times 10^8$ years found by absolute activity measurement (Fleming et al., 1952). A.

539.163

8795. RADIATION FROM ^{192}Pt AND PROPOSED DECAY SCHEME. M.S.Huq.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1456-62 (June, 1957).

By bombarding a gold target at proton energy of 61 MeV the isotopes Pt^{192} and Pt^{191} were indirectly produced. Photographs were taken with the help of a 180° focusing β-ray spectrograph. Of the 207 lines examined, 170 were identified. Those assigned to Pt^{192} and Pt^{191} are given in separate tables. Assignments were aided by intensity measurements under the high resolution of a 180° β-ray spectrometer with crystal detector. A tentative decay scheme for Pt^{192} was also made. A.

539.163.2

8796. THE DECAY OF ^{185}W. I.R.Williams and M.W.Johns.
Nuovo Cimento, Vol. 6, No. 1, 18-22 (July, 1957).

The decay has been studied with a magnetic β-ray spectrometer. The β-spectrum and the electron spectrum from a cadmium converter have been examined down to electron energies of 30 keV. The ground state β-spectrum has an allowed shape and an end-point of (430 ± 4) keV. Since no evidence is found for either internal conversion electrons or γ-rays associated with 55.6 or 125 keV transitions in Re^{185}, it is concluded that β-transitions to such levels do not exist with branching ratios greater than 1.5×10^{-3} and 9×10^{-4}, respectively. A.

539.163.2

8797. THE RADIOACTIVE DECAY OF ^{57}Ni.
J.Konijn, B.van Nooijen, P.Mostert and P.M.Endt.
Physica, Vol. 22, No. 10, 887-97 (Oct., 1956).

The radioactive decay of 36 hr Ni^{57} has been investigated. With a NaI scintillation spectrometer four γ-rays have been found (relative intensities are indicated in percentages of the annihilation peak): γ_1 : 0.127 MeV (30 ± 4); γ_2 : 0.40 ± 0.02 MeV (5.5 ± 3); 0.511 MeV (100); γ_3: 1.363 ± 0.006 MeV (88 ± 5); γ_4 : 1.89 ± 0.02 MeV (14 ± 1). Coincidences were observed between γ_1 and γ_3, while the annihilation radiation is coincident with γ_1, γ_3 and γ_4. With a magnetic lens spectrometer three β^+-branches are observed with the following endpoints and relative intensities: β_1^+ : 0.854 ± ± 0.009 MeV (76 ± 8); β_2^+ : 0.72 ± 0.03 MeV (22 ± 8); β_3^+ : 0.35 ± ± 0.05 MeV (2 ± 1). The energy, K-conversion coefficient and K/L ratio of γ_1 were measured as: 0.1272 ± 0.0005 MeV, $\alpha_K = 0.022 \pm$ ± 0.006 and K/L = 9 ± 4. The angular correlation between γ_1 and γ_3 was measured as: $W(\theta) = 1 - (0.096 \pm 0.009) \cos^2 \theta$. From these data the following spins and parities can be assigned to the three lowest levels in Co^{57}: $E_x = 1.363 \pm 0.006$ MeV ($J = 3/2^-$); $E_x = 1.490 \pm 0.006$ MeV ($J = 1/2^-$) and $E_x = 1.89 \pm 0.02$ MeV ($J = 3/2^-$). The total Ni^{57} decay energy is $Q = 3.24 \pm 0.01$ MeV. A.

539.163.2 : 539.164

8798. SEARCH FOR A RARE α-EMISSION IN ^{228}Ra (MsTh1).
N.Feather, N.Miller and S.W.Peat.
Proc. Phys. Soc. A, Vol. 70, Pt 6, 478-80 (June, 1957).

Experiments using nuclear emulsions did not confirm α/β branching of Ra^{228} but gave upper limits for the branching ratio between 2×10^{-8} and 3×10^{-9} for half-value periods of Em^{224} between 6 min and 200 hr. E.J.Burge

539.165

8799. K-CAPTURE IN CARBON 11. J.Scobie and G.M.Lewis.
Phil. Mag. (Eighth Ser.), Vol. 2, 1089-99 (Sept., 1957).

K-capture in C^{11} has been observed and the K/β^+ ratio found. Comparison with theory leads to a value for the ratio of the Fermi coupling constants. Proportional counters were employed with a gaseous source, and two anti-coincidence systems were used, in turn, to reduce wall effects. One made use of a multi-wire ring type counter and the other utilized an envelope of scintillating material coupled to a photomultiplier. The K/β^+ ratio has been determined at $(1.9 \pm 0.3) \times 10^{-3}$, and accords closely with the theoretical value based on the vanishing of interference terms. A comparison shows that the factor b in beta-decay theory, which determines the ratios of decay coupling constants, is (-0.03 ± 0.10). In this decay between mirror nuclei the Fermi matrix element predominates, and the ratio of the two Fermi coupling constants C_V/C_S has been deduced at (-0.02 ± 0.09), from data on the better known Gamow–Teller constants. The pulse height distribution obtained in these experiments showed that little ionization was produced by the nuclear recoil following neutrino emission, though the recoil energy could be comparable with the 180 eV capture X-ray energy. A.

539.165

8800. PERFORMANCE OF A BETA SCINTILLATION SPECTROMETER. SPECTRA AND CONVERSION COEFFICIENTS OF ^{137}Cs AND ^{207}Bi. R.A.Ricci.
Physica, Vol. 23, No. 7, 693-703 (July, 1957).

The performance of a beta scintillation spectrometer (anthracene crystal) in nuclear spectroscopy has been investigated. A method of calibration of the spectrometer, its resolution and its response to different energies are reported. The nuclides Cs^{137}, Au^{198} and Bi^{207}, which have well known conversion lines, were used for the calibration. The function $(\Delta E)^2/E$ was plotted against the energy and found to be linear in the energy region considered. The spectra of P^{32}, Co^{60}, Au^{198}, and Cs^{137} were analysed. The total conversion coefficient of the 0.662 MeV gamma-ray in the decay of Cs^{137} was computed and found to be 0.114 ± 0.022. The K conversion coefficients of the two stronger gamma-rays in the decay of Bi^{207} were determined with the help of the measured gamma scintillation spectrum and found to be 0.019 (0.57 MeV transition) and 0.114 (1.06 MeV transition). A.

539.165.2

8801. ON THE EQUIVALENCE THEOREM FOR THE MASSLESS NEUTRINO. L.A.Radicati and B.Touschek.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1693-9 (June, 1957).

A new proof is presented of the Serpe–Fierz equivalence theorem for the free neutrino case. The interaction of neutrinos with their sources is seen to restrict the freedom in the neutrino description. It is proved that the only two state theory for the neutrino which does not give rise to double β-decay is the Weyl–Lee–Yang theory. A.

539.165.2

8802. PARITY NONCONSERVATION IN β DECAY.
K.Alder, B.Stech and A.Winther.
Phys. Rev., Vol. 107, No. 3, 728-36 (Aug. 1, 1957).

The nonconservation of parity in β-decay implies that electrons emitted from unoriented nuclei are polarized along their line of flight. Also, if the β process is followed by a γ radiation, the angular distribution of the γ quantum with respect to the electron direction depends on its circular polarization. Formulae relevant for such experiments as well as for the angular distribution of electrons from oriented nuclei are presented. The results, which include Coulomb corrections, are given for scalar, tensor, and pseudoscalar interactions in the cases of allowed and first-forbidden transitions. The formulae show that an experimental determination of the relative sign of the scalar and tensor coupling constants should be possible. A.

539.165.2 : 539.18

8803. KINEMATICS OF β DECAY AND PARITY NONCONSERVATION IN WEAK INTERACTIONS. B.T.Feld.
Phys. Rev., Vol. 107, No. 3, 797-804 (Aug. 1, 1957).

A general description of a Dirac spinor is given in terms of two-component spin wave functions corresponding to its large and small components. These may be used to describe the final states resulting from a β-decay interaction in a form which permits the derivation of angular distributions and correlations by utilization of the quantum-mechanical combination properties of angular momenta. The two-component eigenvectors are such that the one corresponding to the small component of the Dirac spinor has opposite parity from the large component. Hence, this representation is naturally extended to the description of interactions in which parity is not conserved. A general formulation is given for the final-state wave-functions corresponding to such interactions, and is used to discuss the β-decay of unpolarized and polarized nuclei, pions, muons, and heavy mesons. Appropriate choice of the parameters in this description is shown to lead to the two-component neutrino theory of Lee and Yang, Landau, and Salam. Finally, a detailed discussion is given of the consequences of parity nonconservation in the π-meson decay modes of a heavy meson, with particular emphasis on the possibilities of its observation in the τ decay mode of a spin-1 heavy meson. A.

539.166

8804. ON THE γ RADIATION EMITTED BY THE RaD → RaE TRANSMUTATION. M.Frilley and M.Valadares.
J. Phys. Radium, Vol. 18, No. 7, 468-73 (July, 1957). In French.

Nine lines of conversion electrons of the γ radiation 46503 ± 0.015 keV from RaD have been observed by means of a 180° magnetic spectrograph with pre-acceleration. Their relative

intensities have been determined. These results have been compared to those given by the most recent theoretical calculations dealing with internal conversion. In addition some crystalline diffraction spectra of γ-rays and of L-photons have been obtained. A.

539.166

8805. ON THE NEUTRON DEFICIENT ISOTOPES OF THALLIUM, ^{200}Tl AND ^{202}Tl. R.K.Gupta and S.Jha.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1524-7 (June, 1957).

The scintillation spectrometer studies of Ti^{200} have shown that this isotope emits, in addition to the γ-rays reported by Gerholm, γ-rays of energy round 1580 keV, 1680 keV, 1800 keV, 1950 keV and 2100 keV. In the study of Tl^{202}, the ratio of the probabilities of L-electron captures and K-electron captures has been measured by the summing technique. The ratio P_L/P_K, leading to the 440 keV state, is $0.555^{+0.036}_{-0.033}$, from which the total decay energy has been calculated to be 600^{+5}_{-7} keV. A.

539.166

8806. ANISOTROPY AND POLARIZATION OF GAMMA RAYS EMITTED BY ORIENTATED ^{52}Mn NUCLEI.
W.J.Huiskamp, A.N.Diddens, J.C.Severiens, A.R.Miedema and M.J.Steenland.
Physica, Vol. 23, No. 7, 605-21 (July, 1957).

Measurements of the anisotropy of the intensity distribution of the three gamma-rays emitted by polarized Mn^{52} nuclei, yielded the value of the nuclear magnetic moment $\mu = 2.8(+0.8 - 0.5)\,\mu_N$. The sign of the nuclear magnetic moment was shown to be positive from the measurement of the circular polarization of the gamma-rays. It was concluded from the linear polarization of the gamma-rays, that these are all electric quadrupole radiations. Results obtained with aligned nuclei are also reported. A.

539.166.74

8807. DISPERSION RELATIONS FOR COMPTON SCATTERING BY NUCLEONS. N.N.Bogolyubov and D.V.Shirkov.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 3, 529-32 (1957). In Russian.

The Feynman amplitude for the scattering process in a "natural" frame is simply related to the causal amplitude which satisfies the dispersion relations. Conversion to the centre-of-mass frame is discussed. J.W.Gardner

539.166.74

8808. INTERFERENCE IN THE DOUBLE COMPTON EFFECT. B.De Tollis and R.S.Liotta.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 947-54 (April, 1957).

The differential cross-section by double Compton effect is calculated in the case of identity of the two emitted photons. It results a factor of interference $1/(4\pi)^2$ besides the factor 1/137 due to the perturbative development. A.

539.166.75

8809. ON THE AZIMUTHAL DISTRIBUTION OF K PHOTOELECTRONS BY POLARIZED PHOTONS.
D.Brini, L.Peli, O.Rimondi and P.Veronesi.
Nuovo Cimento, Vol. 6, No. 1, 98-110 (July, 1957).

The angular distribution of K-photoelectrons has been investigated in Pb using polarized Compton scattered photons of a Co^{60} source. The selection of the events has been made by associating the photoelectrons to the corresponding fluorescence X-ray. The measurement was performed by determining the behaviour of the asymmetry ratio versus energy: the asymmetry ratio is defined as the number of electrons emitted perpendicularly to the Compton scattering plane divided by the number of those emitted in the scattering plane. The results obtained do not seem to agree with Sauter's theory, but rather with Archibald's calculations. A.

539.166.835

8810. AN ANALYSIS OF THE PAIRS PRODUCED BY ^{8}Be γ-RAYS IN PHOTOGRAPHIC EMULSIONS. D.J.Prowse.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 977-82 (April, 1957).

Electron–positron pairs produced in photographic emulsion by the γ-rays emitted from the proton bombardment of lithium have been analysed. The energy of the pair components has been measured by the multiple scattering technique and using the known values of 17.6 and 14.6 MeV for the γ-ray energies, scattering constants, applicable to the co-ordinate method, of $25.0^{+0.3}_{-1.0}$ and $22.7^{+0.3}_{-1.0}$ have been obtained for no cut off and for a $> 4\bar{\alpha}$ cut-off respectively. The projected angle of opening of the pairs has been measured and a correlation between angle of opening and disparity obtained which agrees fairly well with the theory of Stearns. A.

539.166.835

8811. ELECTRON PAIR-PRODUCTION CROSS SECTIONS AT 2.5 BeV. J.M.Brabant, R.W.Kenney and R.W.Wallace.
Phys. Rev., Vol. 107, No. 2, 604-6 (July 15, 1957).

A lead-glass photon spectrometer has been used to measure the total attenuation cross-section of Pb and Al for photons of energy 2.5 ± 0.5 BeV produced in the Berkeley Bevatron. The electron pair-production cross-sections have been inferred from the measured total cross-sections. Preliminary data indicate that the electron pair-production cross-section is 34.6 ± 6.6 barns in Pb and 1.22 ± 0.17 barns in Al. A.

NUCLEAR REACTIONS 539.17

539.172

8812. CROSS SECTIONS FOR ANTIPROTONS IN HYDROGEN, BERYLLIUM, CARBON, AND LEAD.
B.Cork, G.R.Lambertson, O.Piccioni and W.A.Wenzel.
Phys. Rev., Vol. 107, No. 1, 248-56 (July 1, 1957).

A strong-focusing momentum channel has been arranged to form a beam from antiprotons produced by 6.0 BeV protons striking an internal target of the Bevatron. The channel consists of five 4 in. dia. magnetic quadrupole lenses and two deflecting magnets adjusted to give a ±5% momentum interval. The antiprotons were selected from a large background of mesons by a scintillation counter telescope with a time-of-flight coincidence circuit having a resolution of $\pm 2 \times 10^{-9}$ sec. This system allowed detection of approximately 400 antiprotons per hour. With a liquid hydrogen attenuator, the total antiproton–proton cross-section at four different energies, 190, 300, 500, and 700 MeV, has been observed to be 135, 104, 97, and 94 mb, respectively. Also, the total cross-sections for antiprotons incident on Be and C have been measured at two energies. The inelastic cross-sections for carbon have been measured by observing the pulse heights produced by the interactions in a target of liquid scintillator. To measure the inelastic cross-section for a high-Z element, lead wafers were immersed in the liquid scintillator, and to select inelastic events the pulse heights were measured. A

539.172

8813. ON THE SCATTERING OF HIGH-ENERGY ELECTRONS BY NUCLEI. J.Reignier.
Nuclear Physics, Vol. 3, No. 2, 340-3 (April, 1957). In French.

The model dependence of the scattering of high-energy electrons is discussed on the basis of equivalence laws. It is shown that even at very high energies the angular distribution is insensitive to the central part of the density distribution, but can provide information about the surface region. A

539.172 : 537.533.74

8814. ELECTRON SCATTERING IN NUCLEAR FIELD WITH PAIR-CREATION. E.Montaldi and M.Pusterla.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 961-72 (April, 1957).

By Feynman's graphs, the differential cross-section is computed and the line of calculation of the total cross-section is indicated. A

539.172 : 537.533.7

8815. EFFECTS OF PROTON CORRELATIONS ON THE SCATTERING OF HIGH-ENERGY ELECTRONS FROM NUCLEI. L.I.Schiff.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1223-37 (May, 1957).

Investigates the extent to which the correlations between proton in nuclear matter manifest themselves in the scattering of high-energy electrons from nuclei. The infinite-order Born series is summed, so that dispersion effects that arise from excitation of virtual intermediate nuclear states are included to all orders. Use is made of a high-energy approximation developed earlier, and of the static or adiabatic approximation for the nuclear protons, and these are justified for incident electrons; their validity for nucleon scattering is also discussed. Expressions for the large-angle elastic and inelastic differential scattering cross-sections are obtained in this way. It is then shown that correlation effects are difficult to identify so long as the final nuclear state is well-defined. On the other hand, if a sum over final states is carried out, the effects of short-range correlations between protons appear in a characteristic way in the summed differential cross-section. These results are in qualitative agreement with those obtained earlier by others on the basis of the first and second Born approximation. A

539.172 : 537.533.74

8816. SCATTERING OF FAST ELECTRONS BY POLARIZED NUCLEI. M.Bernardini, P.Brovetto and S.Ferroni.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1292-304 (May, 1957).

Detailed calculations are given of the cross-section for fast electrons on polarized nuclei. The results are applied to the case of Ta^{181}; the predicted azimuthal anisotropy in the cross-section varies from 130% to 50% according to the shape chosen for the distribution of nuclear charge. A.

539.172 : 537.533.74

8817. CONTRIBUTION TO ELASTIC SCATTERING FROM INELASTIC PROCESSES: APPLICATION TO HIGH-ENERGY ELECTRON SCATTERING FROM HYDROGEN AND DEUTERIUM. H.S.Valk.
Nuovo Cimento, Vol. 6, No. 1, 173-86 (July, 1957).

An expression is derived in first Born approximation for the correction to high-energy elastic electron–nucleus scattering arising from the existence of non-radiative inelastic processes. The magnitude of this correction is estimated for electron–proton and electron–deuteron scattering and is shown to be a very small but rapidly increasing function of energy over the range of incident electron energies from 150 to 450 MeV. The correction to electron–deuteron scattering also shows a marked angular dependence increasing with increasing scattering angle. A.

539.172.11

8818. THE RADIATIVE CAPTURE OF ALPHA PARTICLES IN ^{15}N. P.C.Price.
Proc. Phys. Soc. A, Vol. 70, Pt 9, 661-7 (Sept., 1957).

The $N^{15}(\alpha,\gamma)F^{19}$ reaction has been examined with bombarding energy from 1.2 to 2.35 MeV. Three resonances have been found, two narrow and one of measurable width. The cascade schemes at each of the resonances have been partly elucidated, and the partial radiative widths of the resonances have been determined, except for a statistical factor. Some of the angular distributions have been measured, and conclusions are drawn about the possible values of the spins and parities of the levels concerned. The relation of these results to the predictions of Elliott and Flowers is briefly discussed. A.

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172.13

8819. ELASTIC SCATTERING OF 5.7 MeV PROTONS FROM Ni AND Cu. M.Takeda, M.Kondo, S.Kato, C.Hu, R.Nakasima and S.Yamabe.
J. Phys. Soc. Japan, Vol. 12, No. 6, 561-4 (June, 1957).

The angular distributions were studied by means of the nuclear emulsion technique, measurements being made from 14° to 161° at an interval of 5° in the laboratory system. The differential cross-sections, in the ratio to the Rutherford cross-section, have a minimum at about 85° in both cases, but at large scattering angles the cross-section for Ni increases linearly, while there is a maximum at about 130° in the case of Cu. The results are in essential agreement with those of Bromley and Wall. A.

539.172.13 : 539.172.4

8820. COMPARISON BETWEEN (n, p) AND (p, p') EXPERIMENTS ON INTERMEDIATE ENERGY.
L.Colli, U.Facchini and S.Micheletti.
Nuovo Cimento (Ser. 10), Vol. 52, No. 2, 502-9 (Feb., 1957).

An analysis of some experimental results giving proton spectra of (n, p) reactions induced with 14 MeV neutrons on ten elements ranging from Mg to Zr and the spectra of protons emitted in (p, p') reactions from eight elements from Al to Au under bombardment of 18 MeV protons has been carried out. It is evident that such results are not clearly interpreted in the statistical evaporation theory and that level densities of the residual nucleus cannot be derived. Furthermore a relation existing among these spectra is brought to evidence; this relation has been found valid in all comparable cases: the spectra of the protons emitted from (n, p) and (p, p') reactions are the same when the curves are compared versus the energy of the emitted proton. The shape of the spectra, when corrected for the effect of the barrier, does not show strong variations versus the mass number A of the nucleus. A.

539.172.13

8821. INELASTIC PROTON SCATTERING FROM PHOSPHORUS AND ZINC.
D.M.Van Patter, M.A.Rothman, W.C.Porter and C.E.Mandeville.
Phys. Rev., Vol. 107, No. 1, 171-5 (July 1, 1957).

Inelastic proton spectra from targets containing phosphorus and zinc have been studied at bombarding energies of 3.72 and 4.66 MeV using a double-focusing spectrometer. Proton groups have been observed corresponding to levels in P^{31} at 1.264 ± 0.004, 2.230 ± 0.005, 3.134 ± 0.006, and 3.292 ± 0.005 MeV. Excitation curves for these four inelastic groups measured in the region of E_p = 4.55 to 4.70 MeV show the same general resonant structure, although differing in detail. At E_p = 4.66 MeV, no additional groups from P^{31} were observed for the excitation region 0 to 1.26 MeV with an intensity greater than 2% of the intensity of the first excited state group. Four inelastic proton groups were observed from zinc. From a comparison with the known level schemes of the zinc isotopes, three of these groups were assigned to the following isotopes: Zn^{64}, 0.991 ± 0.005 MeV; Zn^{66}, 1.038 ± 0.005 MeV; and Zn^{68}, 1.078 ± 0.005 MeV. The remaining group with Q= -1.802 ± 0.005 MeV remains unassigned. A.

539.172.13

8822. STUDY OF THE $Cu^{65}(p,n)Zn^{65*}$ REACTION BY CONVERSION ELECTRONS. E.M.Bernstein and H.W.Lewis.
Phys. Rev., Vol. 107, No. 3, 737-40 (Aug. 1, 1957).

A magnetic beta-ray spectrometer has been used to study the prompt internal-conversion electrons from low-lying states of Zn^{65} excited by the $Cu^{65}(p,n)Zn^{65*}$ reaction. The data show that there are levels in Zn^{65} at 54 ± 2, 119 ± 2, and 209 ± 3 keV, all levels being excited directly by the p,n reaction. The threshold for exciting the 54 keV level is (2223_{-3}^{+2}) keV, yielding a Q-value of $-(2189_{-3}^{+2})$ keV for the reaction to this level. Neutron branching ratios were calculated from the relative yields of conversion electrons. At a bombarding energy of 3.75 MeV the ratios are 1:8:4 for the neutrons leading to the 54, 119, and 209 keV levels, respectively. A.

539.172.13

8823. PROBABILITIES OF SYMMETRIC AND ASYMMETRIC FISSION IN THE PROTON BOMBARDMENT OF Th^{232}. B.J.Bowles, F.Brown and J.P.Butler.
Phys. Rev., Vol. 107, No. 3, 751-6 (Aug. 1, 1957).

The ratio of symmetric to asymmetric fission in the proton bombardment of Th^{232} does not rise steadily with increasing proton energy; a periodic decrease is superposed upon the over-all increase. This is attributed to the changing pattern of various fission reactions, (p,f), (p,nf), etc. A.

539.172.13

8824. INVESTIGATION OF FOUR RESONANCES IN THE REACTION $^{26}Mg(p,\gamma)^{27}Al$.
C.van der Leun, P.M.Endt, J.C.Kluyver and L.E.Vrenken.
Physica, Vol. 22, No. 12, 1223-33 (Dec., 1956).

The γ-radiation produced in the reaction $Mg^{26}(p,\gamma)Al^{27}$ at four resonances (E_p = 339, 454, 661 and 723 keV) has been investigated with a NaI scintillation spectrometer. Pulse spectra taken at each resonance at angles of $\theta = 0°$ and $\theta = 90°$ to the proton beam were analysed with a 70-channel kicksorter. More information as to the de-excitation of the resonance levels was obtained from γ–γ coincidence measurements. The following spins are deduced from the experiments: 0.84 MeV: J = 1/2; 2.21 MeV: J = (3/2); 2.73 MeV: J = 5/2; 2.98 and/or 3.00 MeV: J = 3/2; 3.68 MeV: J = 1/2; 4.05 MeV: J = 1/2; 8.59 MeV: J = 3/2; 8.70 MeV: J = 1/2; 8.90 MeV: J = 1/2 and 8.96 MeV: J = 3/2. A.

539.172.13

8825. ANGULAR DISTRIBUTION OF PROTONS AND TRITONS FROM THE REACTIONS $Be^9(d,p)Be^{10}$ AND $Be^9(d,t)Be^8$ AT LOW BOMBARDING ENERGIES. R.K.Smither.
Phys. Rev., Vol. 107, No. 1, 196-200 (July 1, 1957).

The angular distributions were measured for incident deuteron energies of 100 keV, 170 keV and 200 keV. A nuclear-plate camera was used in which the relative cross-sections for protons and tritons could be measured at 36 different angles between 15° and 165°. The angular distributions of protons exhibit a minimum yield in the forward direction which increases to a maximum in the backward direction. The angular distributions of tritons also show a minimum cross-section in the forward direction, but the maximum occurs between 120° and 150° and is quite broad. The maximum in the triton cross-section increases in value relative to the cross-section at 90° and moves toward the backward direction as the incident deuteron

energy is decreased. This makes the angular distributions of protons and tritons much more alike in the case of 100 keV incident deuteron energy than for the 200 keV case. The angular distributions were analysed in terms of the first three Legendre polynomials. Their possible relation to compound nucleus formation is discussed. The total cross-section for the $Be^9(d,p)Be^{10}$ reaction was found to be 4.9 ± 2, 16.0 ± 4, and 37.0 ± 10 μb for the incident deuteron energies of 100, 170, and 200 keV, respectively. The ratio of the total cross-section for tritons to the total cross-section for protons was found to be 1.11, 0.97, and 0.91 for deuteron energies of 100, 170, and 200 keV, respectively. A.

539.172.13

8826. REACTIONS $O^{16}(d,p)$, (d,α), AND (d,d) IN THE ENERGY RANGE 3.4 TO 4.2 MeV. E.Baumgartner and H.W.Fulbright.
Phys. Rev., Vol. 107, No. 1, 219-22 (July 1, 1957).

Cross-sections and angular distributions are given for these reactions in the deuteron energy range 3.4 to 4.2 MeV. A.

539.172.13

8827. THEORY OF HIGH-ENERGY DEUTERON SCATTERING. H.P.Stapp.
Phys. Rev., Vol. 107, No. 2, 607-15 (July 15, 1957).

The scattering of high-energy deuterons from spin-zero targets is treated in the framework of the impulse approximation, using the polarization formalism of Wolfenstein and Ashkin, which is here extended to the case of spin-1 particles. The contributions of the deuteron D-state are included and are found to be important in large-angle scattering. The contributions to the deuteron scattering due to the simultaneous scattering of both particles of the deuteron are also included. These contributions are treated by a multitime formalism similar to that used in the Bethe–Salpeter and Lévy–Klein approach to the relativistic two-body wave-equation, but here a slightly different assumption regarding the relative time dependence is made. It is found that these contributions are important at both large and small scattering angles, and account for the large disparity between the experimental and theoretical values of the differential cross-section obtained in previous calculations. A.

539.172.13

8828. d–D REACTIONS AT 6 TO 14 MeV INPUT ENERGY. J.E.Brolley, Jr, T.M.Putnam and L.Rosen.
Phys. Rev., Vol. 107, No. 3, 820-4 (Aug. 1, 1957).

Differential cross-sections for both branches of the d–D reaction have been obtained over the input energy interval 6 to 14 MeV by charged-particle measurements utilizing a nuclear multiplate camera. Legendre expansions are given which permit interpolation of the data over both energy and angle. A.

539.172.13

8829. AN INVESTIGATION OF THE REACTION $^{31}P(d,p)^{32}P$ BY MAGNETIC ANALYSIS. A.W.Dalton, S.Hinds and G.Parry.
Proc. Phys. Soc. A, Vol. 70, Pt 8, 586-92 (Aug., 1957).

The energy spectra of the protons emitted from a phosphorus target when bombarded by 8.9 MeV deuterons have been measured by magnetic analysis and a number of levels not previously reported have been observed. The angular distributions of 17 proton groups have been measured, and in most cases these have been fitted with theoretical stripping curves enabling parity and possible spin assignments to be made to some states of P^{32}. Seven of these angular distributions show a dip below the Butler stripping curve at small angles, but otherwise correspond to l = 1 transitions. A.

539.172.3

8830. THE ELASTIC SCATTERING OF PHOTONS BY COPPER. J.B.Bellicard, J.Miller and C.Tzara.
J. Phys. Radium, Vol. 18, No. 3, 201-2 (March, 1957). In French.

The activation of a Cu detector by bremsstrahlung radiation scattered from a Cu block was measured as a function of the high-energy limit of the photon spectrum in the range 18 to 22 MeV. The analysis shows that the cross-section reaches a maximum at about 18 MeV. M.A.Grace

539.172.3

8831. ON γ-POLARIZATION EFFECTS IN PHOTONUCLEAR REACTIONS. A.Agodi.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 21-9 (Jan., 1957).

A detailed derivation is given of the most general angular distribution of photonucleons consistent with the conservation principles for angular momentum and parity. Its azimuthal dependence, when photons are linearly polarized, is discussed, with particular emphasis on the physical information obtainable without using any model for the reaction or the nucleus. A.

539.172.3

8832. POLARIZATION OF NUCLEONS FROM PHOTODISINTEGRATION OF DEUTERIUM. W.Czyż and J.Sawicki.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 45-56 (Jan., 1957).

The polarization of nucleons from the $D(\gamma,n)$ reaction is investigated under the assumption of tensor coupling in the n–p interaction potential. Dipole electric and dipole magnetic transitions are taken into consideration. The polarization is estimated for $\hbar\omega$ = 40 MeV with the help of recent p–p scattering phase-shifts. For sake of illustration the polarization is given for the very singular L·S Case and Pais force in Born approximation and for the weak tensor forces of Rarita and Schwinger. The polarization is sensitive to the type of interaction. The general scheme of calculation of the reaction amplitude for tensor forces is given. The quadrupole electric corrections to the polarization are discussed. A.

539.172.3

8833. PHOTOPROTONS FROM OXYGEN UP TO 30 MeV. C.Milone, R.Ricamo and R.Rinzivillo.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 532-4 (Feb., 1957).

The yield of photoprotons (Ep > 1.5 MeV) from oxygen was studied as a function of betatron energy using loaded emulsions and it shows a smooth increase up to 30 MeV. This increase is attributed to a giant resonance for the (γ,p) reaction by E 1 absorption in the 20-25 MeV photon energy range. M.A.Grace

539.172.3

8834. ANGULAR DISTRIBUTION OF PHOTOPROTONS FROM OXYGEN. C.Milone and R.Ricamo.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1338-9 (May, 1957).

Measurements with a bremsstrahlung beam of 30 MeV maximum energy, using normal and water loaded C2 nuclear emulsions, showed that the angular distribution of protons with energies between 4 and 8 MeV was symmetrical about 90°. The curve can be fitted by $(a + b\sin^2\theta)$ and it is concluded that the $O^{16}(\gamma,p)$ reaction for E_γ near 25 MeV is due to E1 photon absorption. See also Abstr. 1612 (1957). E.J.Burge

539.172.3

8835. COMPARATIVE YIELDS OF $(\gamma,2n)$ AND (γ,pn) PROCESSES FOR Fe^{54} INDUCED BY 70 MeV BREMSSTRAHLUNG. R.M.Henry and D.S.Martin, Jr.
Phys. Rev., Vol. 107, No. 3, 772-4 (Aug. 1, 1957).

Relative yields of $Fe^{54}(\gamma,2n)Fe^{52}$: $Fe^{54}(\gamma,pn)Mn^{52}$: $Fe^{54}(\gamma,pn)Mn^{52}$ were found to be 1 : 8 : 19 for irradiations by 70 MeV bremsstrahlung. These yields were compared with yields of the same products by alpha-particle bombardment, and results were discussed in terms of a statistical model for the reactions. A.

539.172.4

8836. THE $^{121}Sb(n,p)^{121}Sn$ REACTION. Z.Wilhelmi and N.I.Pirogov.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 5, No. 4, 401-5 (1957).

A sandwich of iron and antimony was irradiated with fast neutrons up to 14.8 MeV from the $Be^9(d,n)B^{10}$ reaction in the cyclotron at the Soviet Academy of Science Institute. Tin was chemically separated and Sn^{121} was identified by half-life and by β energy. The ratio of cross-sections of the reactions $Sb^{121}(n,p)Sn^{121}$ and $Fe^{56}(n,p)Mn^{56}$ was found to be $\sigma Sn^{121}/\sigma Fe^{56}$ = 0.040 ± 0.010. An approximate theory gave value 0.055. J.H.Fremlin

539.172.

8837. THE (n,α) REACTION OF 14 MeV NEUTRONS WITH CADMIUM. B.G.Dzantiev, V.N.Levkovskiĭ and A.D.Malievskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 3, 537-40 (1957). In Russian.

Radiochemical separation and counter study gives cross-sections for $Cd^{113}(n,\alpha)Pd^{109}$, $Cd^{114}(n,\alpha)Pd^{111}$, $Cd^{114}(n,\alpha)Pd^{111*}$ and $Ag^{109}(n,p)Pd^{109}$ as 0.51 ± 0.13, 0.13 ± 0.04, 1.35 ± 0.27 and 10.5 ± 2.0 millibarns respectively. W.O.Lock

539.172.

8838. CROSS-SECTION FOR THE REACTIONS Cd(n,p)Ag AT NEUTRON ENERGY OF 14 MeV. V.N.Levkovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 5, 1032-4 (1957). In Russian.

The cross-section was calculated by comparing the β-emission of the above reaction with the β-emission of the reaction $Cd^{112}(n,\alpha)Pd^{109}$ which was investigated earlier (see preceding abstract). The following values were obtained:

$Cd^{106}(n,p)Ag^{106}$ (24 min)	: 76 ± 24 millibarns,
$Cd^{111}(n,p)Ag^{111}$	: 15 ± 3.8 millibarns,
$Cd^{112}(n,p)Ag^{112}$	: 9.8 ± 2.9 millibarns,
$Cd^{113}(n,p)Ag^{113}$	: 7.2 ± 2.2 millibarns.

S.Chome

539.172.4

8839. A STUDY OF PROTONS EMITTED FROM ALUMINIUM, IRON AND RHODIUM ON BOMBARDMENT WITH NEUTRONS OF 13.2 MeV. G.Brown, G.C.Morrison, H.Muirhead and W.T.Morton.
Phil. Mag. (Eighth Ser.), Vol. 2, 785-96 (June, 1957).

The angular distributions and energy spectra of the protons emitted through the interaction of neutrons with an energy of 13.2 MeV with natural aluminium, iron and rhodium, have been studied using photographic emulsions. The experimental results have been compared with the predictions of a model which assumes that these protons can be emitted by two processes: by direct collisions of the incident neutron with a proton in the target nucleus and by the decay of a compound nucleus. Evidence for the process of direct interaction has been obtained in all cases. A.

539.172.4

8840. NEUTRON EMISSION PROBABILITIES FROM THE INTERACTION OF 14-MeV NEUTRONS WITH Be, Ta, AND Bi. L.Rosen and L.Stewart.
Phys. Rev., Vol. 107, No. 3, 824-9 (Aug. 1, 1957).

The spatial and spectral distributions of the neutrons were obtained by using nuclear emulsion detectors in conjunction with a neutron collimator. These results indicate that roughly 85 to 90% of the interactions proceed via compound-nucleus formation while approximately 10 to 15% proceed by "direct" interactions. The space-integrated neutron spectrum has been obtained for Be by means of a sphere experiment. Cross-sections for neutron emission, nonelastic scattering (n,n'), and (n,2n) are derived for all three elements. A.

539.172.4 : 518.5 : 681.142 : 621.317.79

8841. THE APPLICATION OF ANALOGUE METHODS TO COMPUTE AND PREDICT XENON POISONING IN A HIGH-FLUX NUCLEAR REACTOR. G.J.R.MacLusky.
Proc. Instn Elect. Engrs, Paper 2338M, publ. March, 1957 (Vol. 104B, 443-6, 447-51).

Republication, with discussion, of the paper abstracted in Abstr. 3685 (1957).

539.172.4

8842. FAST NEUTRON CAPTURE BELOW 1 MeV: THE CROSS SECTIONS FOR ^{238}U AND ^{232}Th. A.M.Lane and J.E.Lynn.
Proc. Phys. Soc. A, Vol. 70, Pt 8, 557-70 (Aug., 1957).

Recent measurements of neutron capture in U^{238} and Th^{232} with neutron energies up to 1 MeV reveal anomalies in the capture cross-sections. An attempt has been made to fit these cross-sections in terms of conventional compound nucleus theory, using the existing low energy resonance data to provide numerical values of the widths and other parameters. If one assumes some definite dependence of level density on energy, there are no free parameters left in the fitting. The level density formula of Lang and Le Couteur has been used, and good absolute fits found with the observed capture cross-sections. It emerges in the fitting that the anomalies are a consequence of the small rate of increase of the number of inelastic scattering channels with energy. This small rate is a result of the rotational nature of the low-lying spectra of U^{238} and Th^{232}. A.

539.172.4

8843. ANGULAR CORRELATIONS IN HIGH ENERGY FISSION. L.Marquez.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1646-50 (June, 1957).

The existence of an angular correlation between the incident beam of nucleons and the fission fragments in high energy fission of heavy elements leads to the conclusion that the number of neutrons evaporated before fission is probably zero or very small. A.

539.172.4

8844. ANGULAR DISTRIBUTION OF FRAGMENTS FROM THE FISSION OF BISMUTH BY 450 MeV PROTONS.
R.L.Wolke and J.R.Gutmann.
Phys. Rev., Vol. 107, No. 3, 850-5 (Aug. 1, 1957).

The angular distributions of three fragments from the 450 MeV proton-induced fission of Bi have been measured by a recoil-catching technique involving radiochemical separation of the fission products. The forward velocity component of the fissioning nucleus was determined relative to the velocity of each fragment. If it is assumed that the motion of the fissioning nucleus is directed along the proton axis, the angular distributions in the system of the fissioning nucleus are found to be of the form $a + b\cos^2\theta'$, with values of b/a of 0.10 ± 0.01, 0.115 ± 0.015, and 0.09 ± 0.01 for $Ga^{72,73}$, $Sr^{91,92}$, and $Cd^{115,117}$, respectively. The possibility that the motion of the fissioning nucleus is directed at an angle to the proton axis is discussed. A.

539.172.4

8845. THE FISSION CROSS SECTIONS OF ^{233}U, ^{235}U, ^{238}U AND ^{239}Pu FOR NEUTRONS IN THE ENERGY RANGE 0.030 MeV TO 3.0 MeV. W.D.Allen and A.T.G.Ferguson.
Proc. Phys. Soc. A, Vol. 80, Pt 8, 573-85 (Aug., 1957).

The fission cross-sections have been measured as a function of neutron energy, and in addition, measurements of the ratios of the fission cross-sections as a function of neutron energy have been made. The fission cross-sections and the ratios have been shown to be consistent and a set of best values of the cross-sections has been computed. The accuracy over most of the range is to about 3% falling to 5% at the extremes. A.

539.172.4

8846. ABSOLUTE NEUTRON AND GAMMA-RAY SPECTRA OF JEEP MEASURED BY MEANS OF NUCLEAR EMULSIONS. S.Selim-Younis.
JENER Rep., No. 47, 12 pp. (1957).

The fast neutron spectrum of this reactor has been measured by observing recoils and its gamma-ray spectrum by photodisintegration in deuterium-loaded emulsions. J.W.G.Wignall

539.172.4 : 621.316.95

8847. SAFETY CIRCUIT DEVELOPMENT AT BROOKHAVEN NATIONAL LABORATORY.
J.E.Binns, W.Lones, D.G.Pitcher and M.Mélice.
Trans Amer. Inst. Elect. Engrs I, Vol. 76, 365-8 (1957) = Commun. and Electronics, No. 31 (July, 1957).

A trip-signal meter system for nuclear reactors which operates on neutron detection is described. Three independent channels are employed. Each channel incorporates a signal proportional to reactor power derived from an uncompensated ion chamber, and a signal proportional to inverse period derived from a gamma-compensated pair of ion chambers by way of a period amplifier. The trip signal is arranged as the sum of the two signals. R.W.J.Cockram

ATOM AND MOLECULE BEAMS. MESONS. NEUTRONS 539.18

539.18

8848. A HYPERON MODEL. G.Wentzel.
Helv. phys. Acta, Vol. 30, No. 2-3, 135-42 (1957).

A study is made of a nucleonic particle having three elementary states of neutron, proton, and lambda character, coupled with a K-meson field by Yukawa interactions. The binding of K-mesons gives rise to a spectrum of states which contains all levels of Gell-Mann's hyperon scheme, but also other levels, all of them at higher energies with one exception. A.

539.18

8849. INTERFERENCE EFFECTS BETWEEN MEMBERS OF PARITY DOUBLETS IN THE LEE–YANG THEORY. R.Gatto.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1021-3 (May, 1957).

Lee and Yang have shown that from the assumption that the approximate equality of masses of the τ- and θ-mesons follows from a symmetry principle it follows that particles of odd strangeness exist in parity doublets. It could be possible to observe in some cases interferences between amplitudes relative to the two components of doublets. It can be shown, for example, that the angular correlation in the cascade $\Xi^- \to \Lambda^0 + \pi^-$, $\Lambda^0 \to p + \pi^-$ is given by

$$F(\cos\theta) = \exp[-\lambda_+ t]\,F_+(\cos\theta) + \exp[-\lambda_- t]\,F_-(\cos\theta) + \exp[-\tfrac{1}{2}(\lambda_+ + \lambda_-)t]\cos(\nu_+ - \nu_-)t\,F'(\cos\theta)$$

where λ_+, λ_-, and ν_+, ν_- are the inverse lifetimes and masses of Λ^0_+, Λ_- respectively, $F_+(\cos\theta)$ and $F_-(\cos\theta)$ are symmetric for $\theta \to \pi - \theta$, while $F'(\cos\theta)$ is antisymmetric; t is the time the Λ^0 has lived. The oscillatory interference term will be observable only if the mass difference is $\sim 10^{-5}$ eV or smaller. If the electromagnetic interaction is minimal only the weak interactions can contribute to the mass differences which could result in this case $\sim 10^{-5}$ eV or smaller. Quite similar considerations can be developed for the correlation in the cascade $(K^- + p)_{bound} \to Y + \pi$, $Y \to N + \pi$. A.

539.18

8850. VECTORIAL CHARGE DISPLACEMENT. D.C.Peaslee.
Nuovo Cimento, Vol. 6, No. 1, 1-6 (July, 1957).

The consequences are examined of recognizing an extreme symmetry between the nucleon and cascade (Ξ) particle. The simplest formalism for expressing this symmetry is to take the charge displacement number $a = q - I_z$ for heavy particles as the z-component

of a second, independent vector A in charge space. This scheme makes evident the possibility of two independent charge conjugation operators C and C' for heavy particles: it also has suggestive applications to the θ_1, θ_2 scheme and the π–e decay problem. Experimental tests for vectorial A appear remote; the scheme appears mainly as an ideal limiting case, which may be useful for comparison and contrast with the real situation. A.

539.18

8851. ON THE THEORY OF HYPERONS AND K-MESONS.
J.Tiomno.
Nuovo Cimento, Vol. 6, No. 1, 69-83 (July, 1957).

An analysis is made of the consequences of the well established law of conservation of "strangeness" on the schemes of quantum numbers attributed to hyperons and K-mesons. It is shown that the usually accepted Gell-Mann–Nishijima scheme is not unique and that another scheme in which isotopic spin 0 is attributed to K-mesons and ½ to (Λ,Σ) particles is possible. A theory is developed based on general symmetry principles, with this new scheme, and it is shown that, at the stage when only interactions of K-mesons with hyperons are introduced, it is equivalent to Schwinger's 4-dimensional (in isotopic spin space) theory. Some features of interactions of π-mesons with hyperons are considered, as well of weak interactions. One of these features is that for the interactions of the π-mesons with (Λ,Σ) particles the conservation of the isotopic spin may be lost (with the selection rule $\Delta I_3 = 0, \pm 1$) with the new definition of isotopic spin. A.

539.18

8852. EXAMPLES OF THE PRODUCTION OF $(K^0,\bar{K}^0)$ AND (K^+,K^0) PAIRS OF HEAVY MESONS.
W.A.Cooper, H.Filthuth, J.A.Newth, G.Petrucci, R.A.Salmeron and A.Zichichi.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1388-97 (June, 1957).

Two simple nuclear interactions that produce pairs of K-mesons are described and discussed. They are interpreted as examples of the processes $n + p \rightarrow K^0 + \bar{K}^0 + n + p$ and $n + p \rightarrow \bar{K}^+ + K^0 + n + n$ where $\bar{K}^0$ is the antiparticle of the K^0-meson. A.

539.18

8853. PROBABLE NUCLEAR INTERACTION OF A HYDROGEN HYPERNUCLEUS. R.Levi-Setti and W.Slater.
Nuovo Cimento, Vol. 6, No. 1, 51-62 (July, 1957).

A particle (A) of unit charge, mass (3.6 ± 1.1) proton masses, and velocity $v = (0.26 \pm 0.02)c$, is emitted from a 4.5 GeV π-star in emulsion. After travelling 2.4 mm, particle A interacts with a nucleus of the emulsion, the only visible product being a helium hypernucleus, identified by direct mass and charge measurements, and by its mesonic decay. The energy of particle A is insufficient to produce directly the observed He_Λ, and the multiple scattering and ionization results on track A are inconsistent with its being a heavy meson or hyperon interacting in flight. The most probable interpretation is to identify particle A as a hydrogen hypernucleus which interacts by charge exchange or proton pickup. A.

539.18

8854. POLARIZATION OF μ-MESONS OBSERVED IN A PROPANE BUBBLE CHAMBER. M.H.Alston, W.H.Evans, T.D.N Morgan, R.W.Newport, P.R.Williams and A.Kirk.
Phil. Mag. (Eighth Ser.), Vol. 2, 1143-6 (Sept., 1957).

3734 $\pi^+ \rightarrow \mu^+ \rightarrow e^+$ decays have been observed in a propane bubble chamber and the angular distribution of the positrons found to be $(dN/d\Omega) \propto 1 - (0.16 \pm 0.04)\cos\theta$. The decay and absorption of μ^--mesons in propane have also been investigated. A.

539.18

8855. EVIDENCE FOR A HEAVY NEUTRAL K-PARTICLE AND ITS CASCADE DECAY. M.S.Sinha and S.N.Sengupta.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1153-8 (May, 1957).

Two cases of V^0-decays have been obtained in both of which one of the secondaries is found to be heavier than a pion and is found to decay into a thinly ionizing particle at the end of its range. Approximate momenta and ionization estimates lead to a low Q-value of about 10 MeV if the secondaries are taken to be a K and a π-meson. These events therefore give evidence for the existence and cascade decay of a neutral heavy meson of mass near about 1270 m_e. This particle is believed to be a bound excited state of an ordinary K-meson with a pion. A.

539.18

8856. POSSIBLE EXPLANATIONS OF THE DECAY PROCESSES OF THE PION IN THE FRAME OF THE "UNIVERSAL" FERMI INTERACTION. G.Morpurgo.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1159-65 (May, 1957).

Two possible independent ways of reconciling the observed rates of the pion decay processes with the predicted values which one obtains if the processes take place through the "universal" Fermi interaction are suggested; one depends on the freedom which one has in establishing the correspondence between PNeν and PN$\mu\nu$, the other on the modifications which the value of the ratio $|g_A|^2/|g_T|^2$ of the axial to the tensor coupling constant may suffer on account of the possible non invariance under time reversal of the β interaction. The predicted values for the ratios between the rates of the processes $\pi \rightarrow e + \nu$, $\pi \rightarrow e + \nu + \gamma$ and $\pi \rightarrow \mu + \nu$ are compatible with the present evidence. A.

539.18

8857. IONIZATION AT THE ORIGIN OF HIGH ENERGY ELECTRON POSITRON PAIRS. G.Yekutieli.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1381-7 (June, 1957).

The ionization at the origin of a high-energy ($E > 50$ GeV) electron-positron pair is calculated, and the results are compared with experiment. A.

539.18

8858. ON THE ANGULAR CORRELATION IN THE β-DECAY OF μ-MESONS OBSERVED IN PHOTOGRAPHIC EMULSION.
B.Bhowmik, D.Evans and D.J.Prowse.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1663-9 (June, 1957).

The anisotropy of the distribution in the angle θ, between the direction of emission of the positron and that of the μ-meson, has been measured in stripped emulsion stacks exposed to the cosmic radiation. Assuming a distribution of the form $(1 + a\cos\theta)$ a value of -0.081 ± 0.05 has been obtained for "a". This result is compared with those obtained by other workers and the depolarizing effects of photographic emulsion are discussed. A.

539.18

8859. SYSTEMATICS OF Λ^0 AND θ^0 DECAY.
F.Eisler, R.Plano, N.Samios, M.Schwartz and J.Steinberger.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1700-15 (June, 1957).

Systematic observations on 528 Λ^0–θ^0 production events in propane have yielded the following information: (1) There exists a neutral Λ^0 decay; $\Lambda^0 \rightarrow \pi^0 + n$ and the fraction of Λ^0's decaying in this mode is 0.32 ± 0.05. (2) The θ_2^0 component has a neutral decay mode, very probably $\theta_1^0 \rightarrow \pi^0 + \pi^0$. The θ^0 therefore very probably has even spin. The fraction $\frac{P(\theta_1^0 \rightarrow \pi^0 + \pi^0)}{P(\theta_1^0 \rightarrow 2\pi)}$ is 0.14 ± 0.06. The branching ratio $\frac{P(\Lambda^0 \rightarrow \pi^0 + n)}{P(\Lambda^0 \rightarrow \pi^- + n)}$ is in good agreement with the $I = ½$ selection rule; the branching ratio $\frac{P(\theta^0 \rightarrow 2\pi^0)}{P(\theta^0 \rightarrow \pi^+ + \pi^-)}$ seems to be in disagreement. (3) $(51 \pm 7.5)\%$, or just one half of the θ^0 mesons escape the chamber and are to be identified with the θ_2^0-meson proposed by Gell-Mann and Pais. The question of the existence of additional (parity doublet) decay modes is discussed. (4) The decay $\Lambda^0 \rightarrow \frac{\mu^- + p + \nu}{e^- + p + \nu}$ are not observed and the fraction of such decays is less than 2%. (5) The 3-particle decay modes of the θ_1^0 have not been observed and are therefore very unlikely to exceed 2% of all θ_1^0 decays. (6) Preliminary measurements yield lifetimes $\tau_{\theta_1^0} = (0.95 \pm 0.08) \times 10^{-10}$ sec and $\tau_{\Lambda^0} = (2.8 \pm 0.2) \times 10^{-10}$ sec. (7) For the θ_2^0 a lower limit of the lifetime is obtained, which together with the results of Lande et al. brackets the θ_2^0 lifetime $(3 < \theta_2^0 < 10) \times 10^{-8}$ sec. A.

539.1

8860. AN ANALYSIS OF 419 τ-MESON DECAYS.
M.Baldo-Ceolin, A.Bonetti, W.D.B.Greening, S.Limentani, M.Merli and G.Vanderhaeghe.
Nuovo Cimento, Vol. 6, No. 1, 84-97 (July, 1957).

A homogeneous sample of 419 τ-decays found in nuclear emulsions exposed to the Berkeley Bevatron has been used. Special attention has been given to reducing the effects of the experimental biases both for the scanning and for the analysis. The results show that the τ-decay is nearly isotropic, corresponding in the Dalitz treatment to zero spin and negative parity. A

539.18

8861. THE DECAY OF A Σ^+ HYPERON-PROTON FRAGMENT. M.Baldo-Ceolin, W.F.Fry, W.D.B.Greening, H.Huzita and S.Limentani.
Nuovo Cimento, Vol. 6, No. 1, 144-9 (July, 1957).

An event has been found in an emulsion stack which is interpreted as a (Σ^+, proton) compound which decayed from rest into a pion, a proton and a neutron with an energy release of (106 ± 14) MeV. A.

539.18

8862. THE BREAKDOWN OF PARITY CONSERVATION IN THE $\pi-\mu-e$ DECAY AND A TEST OF THE TWO COMPONENT NEUTRINO THEORY. G.B.Chadwick, S.A.Durrani, L.M.Eisberg, P.B.Jones, J.W.G.Wignall and D.H.Wilkinson.
Phil. Mag. (Eighth Ser.), Vol. 2, 684-93 (May, 1957).

6149 complete $\pi-\mu-e$ events have been measured in nuclear emulsion. 3021 events were in ordinary Ilford G5 emulsion and 3128 were in G5 emulsion containing twice the usual amount of gelatin relative to halide. The angular correlation between the initial directions of motion of μ-meson and electron, after possible edge effects have been eliminated, is of the form $1 - (0.149 \pm 0.033)\cos\theta$ in ordinary emulsion and $1 - (0.190 \pm 0.033)\cos\theta$ in diluted emulsion. This demonstrates conclusively the breakdown of parity conservation and charge conjugation in both steps of the $\pi-\mu-e$ process. It is shown that, with the aid of other data, the partial quenching of the μ-meson's initial spin orientation may be eliminated from these data and the true correlation of the fundamental process obtained: it is $1 - (0.283 \pm 0.060)\cos\theta$. This asymmetry is consistent with the prediction of the two-component neutrino theory with

$$(|f_A|^2 + |f_V|^2)^{-1}(f_V f_A^* + f_A f_V^*) = 0.85 \pm 0.18.$$

A.

539.18

8863. POLARIZATION OF ELECTRONS IN MUON DECAY AND THE TWO-COMPONENT THEORY OF THE NEUTRINO. T.Kinoshita and A.Sirlin.
Phys. Rev., Vol. 106, No. 5, 1110-11 (June 1, 1957).

On the basis of the two-component neutrino theory expressions are derived for the polarization of electrons emitted in the decay of polarized muons. Measurement of the angular dependence of the former would give the muon polarization. There is an effect even if the latter is zero. J.W.G.Wignall

539.18

8864. ISOTOPIC SPIN SELECTION RULE $|\Delta I| = 1/2$ FOR THE DECAYS OF STRANGE PARTICLES. M.Kawaguchi.
Phys. Rev., Vol. 107, No. 2, 573-6 (July 15, 1957).

Decay processes of strange particles are re-examined under the assumption of the selection rule $|\Delta I| = \frac{1}{2}$, when all particles concerned have isotopic spins, but parity is not necessarily conserved. Some of the results obtained before still hold as they are, even if parity nonconservation is taken into consideration. However, the relation between the branching ratio $(\Sigma^+ \to p + \pi^0)/(\Sigma^+ \to n + \pi^+)$ and the ratio of lifetimes $\tau(\Sigma^-)/\tau(\Sigma^+)$ is changed by parity nonconservation. The experimental results on Σ particles may be interpreted as indicating comparable magnitudes for parity-conserving and parity-nonconserving terms. Some results based on $|\Delta I| = \frac{1}{2}$ and $\frac{3}{2}$ are also discussed for these particles. A.

539.18

8865. MUON DECAY WITH PARITY NONCONSERVING INTERACTIONS AND RADIATIVE CORRECTIONS IN THE TWO-COMPONENT THEORY. T.Kinoshita and A.Sirlin.
Phys. Rev., Vol. 107, No. 2, 593-9 (July 15, 1957).

The decay of a polarized muon is studied in the case of the general four-component neutrino theory with the most general parity-nonconserving interaction. A three-parameter formula for the decay-electron distribution is obtained as a generalization of the Michel formula for an unpolarized muon. This general formula is examined to determine to what extent the observed spectrum enables one to decide whether any particular theory is correct or not. It is seen, among other things, that by the observation of the muon decay spectrum alone one cannot test the validity of the two-component neutrino theory. To facilitate a possible accurate experimental test of the two-component theory, the radiative correction for the decay of a polarized muon is worked out to the lowest order in α. Although the correction is rather complicated, it can still be expressed approximately by the three-parameter formula mentioned above. It is found, in particular, that the corrected Michel parameter for the two-component theory is 0.70$_6$ when a neutrino and an antineutrino are emitted in the final state, which is 6% smaller than the value 0.75 predicted by the simple theory. A.

539.18

8866. THE LIFETIME OF POSITIVE HEAVY MESONS. B.Bhowmik, D.Evans, S.Nilsson, D.J.Prowse, F.Anderson, D.Keefe, A.Kennan, N.N.Biswas, M.Ceccarelli, P.Waloschek, J.E.Hooper, M.Grilli and L.Guerriero.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 994-1003 (April, 1957).

Over two hundred examples of the decay in flight of positive heavy mesons produced at the Bevatron have been observed in photographic emulsions, and from these the lifetime of the particles has been estimated. The lifetime averaged over all modes of decay is found to be $1.35^{+0.16}_{-0.13} \times 10^{-8}$ sec. The effect of experimental biases is discussed, and the final result is compared with that of other authors. A.

539.18

8867. ANGULAR CORRELATION IN THE $\pi-\mu-e$ DECAY OF COSMIC RAY MESONS. P.H.Fowler, P.S.Freier, C.M.G.Lattes, E.P.Ney and S.J.St.Lorant.
Nuovo Cimento, Vol. 6, No. 1, 63-8 (July, 1957).

A measurement has been made of the angular correlation in the decay for mesons produced at high altitude by cosmic-rays incident on a 22.4 litre emulsion stack. Within the statistics the angular distribution of the electrons is isotropic. The value of "a" in the expression $dN/d\Omega = (1 + a\cos\theta)$ is -0.03 ± 0.04. This result is in disagreement with the experiments using accelerator-produced mesons which show a backwards asymmetry with "a" = -0.15 ± 0.02. Possible explanations for the difference are discussed. A.

539.18

8868. OBSERVATIONS ON THE $\pi^+ \to \mu^+ \to e^+$ ANGULAR CORRELATION IN NUCLEAR EMULSION. D.F.Davis, A.Engler, C.J.Goebel, T.F.Hoang, M.F.Kaplon and J.Klarmann.
Nuovo Cimento, Vol. 6, No. 2, 311-18 (Aug., 1957).

The asymmetry coefficient characterizing the angular correlation in the $\pi-\mu-e$ decay has been measured in emulsion as -0.19 ± 0.06 for a sample of π^+ mesons produced at the Brookhaven Cosmotron. A discussion is given concerning depolarization effects in nuclear emulsion. A.

539.18

8869. MASS MEASUREMENTS OF PARTICLES STOPPING IN THE EMULSION BY THE CONSTANT SAGITTA METHOD. B.Judek.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 886-95 (April, 1957).

Scattering measurements by the constant sagitta method, using a scattering scheme based on the Göttingen tables, were made on tracks of particles stopping in the emulsion and at least 3 cm long. The following general results were obtained: (i) The mean value of the sagitta, $\bar{D}$, for protons was found to be about 3% in excess of the theoretical value. (ii) The spread of the experimental observations of $\bar{D}$ corresponds quite closely to its expected statistical value calculated on the basis of the $75/\sqrt{N}\%$ formula for the standard error. A good resolution for proton and deuteron groups was obtained on the basis of 3 cm and 2 cm track lengths. (iii) The range-energy exponent deduced from the observations on deuteron/proton and triton/proton mass ratios and from the variation of the value of $\bar{D}$ with residual range was found to be in good agreement with the value 0.568 of Fay et al. and Vigneron. (iv) No particle corresponding to a 1450 m_e meson suggested by Fowler and Perkins was observed, although the present statistics are not sufficient to exclude definitely the existence of such a particle. A.

539.18

8870. MULTIPLE SCATTERING MEASUREMENTS OF π AND μ MESONS STOPPING IN NUCLEAR EMULSIONS. B.Judek.
Canad. J. Phys., Vol. 35, No. 8, 980-2 (Aug., 1957).

Good agreement was found between the experimental values for 28 π mesons and 5 μ mesons and the values given by Fay, Gottstein and Hain (Abstr. 10767/1954). The standard deviations were in agreement with theory and the mean of the second differences did not vary with residual range. See also preceding abstract. E.J.Burge

539.18

8871. ON A POSSIBLE TRANSITION DIPOLE-MOMENT OF Λ-PARTICLES. B.L.Ioffe and I.Ya.Pomeranchuk.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 6, 1251-4 (1957). In Russian.

The consequences of the hypothesis that the Λ-particle has a transition dipole-moment given by $d = er_0 s C_p$, where r_0 is a constant having dimensions of length, s is the spin, and $C_p = \left(\begin{smallmatrix} 0 & 1 \\ 1 & 0 \end{smallmatrix}\right)$, are investigated. In particular, the role played by such a dipole moment in the scattering of Λ-particles by the Coulomb field of the nucleus, and the formation of levels in this field, are discussed quantitatively. S.Chomet

539.18

8872. PARITY VIOLATION AND THE SPIN OF THE Λ^0 PARTICLE. F.Cerulus.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1685-92 (June, 1957).

The ratio of non-mesonic to mesonic decay is calculated using a phenomenological Hamiltonian for the Λ-decay interaction and for the pion–nucleon interaction. In the calculation the absorption by the nucleons of charged and neutral virtual pions from the Λ is taken into account, and parity conservation in the Λ-decay is not assumed. If parity were strongly violated, a comparison of the results of the calculation with experiment would indicate that the Λ has spin ½. If the parity violation is slight, spin ⅜ is still possible. The value of the ratio of non-mesonic to mesonic decay is calculated numerically for $_{\Lambda}He^4$, $_{\Lambda}H^4$ and $_{\Lambda}Be^8$ under different assumptions about spin and parity. A.

539.18

8873. NUCLEAR SCATTERING OF K^+-MESONS IN THE ENERGY REGION OF 80 MeV. N.N.Biswas, L.Ceccarelli-Fabbrichesi, M.Ceccarelli, K.Gottstein, N.C.Varshneya and P.Waloschek.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 123-41 (Jan., 1957).

The scattering of K^+-mesons by nuclei in photoemulsions has been investigated in the 60 to 100 MeV region. Data on 27 collisions of K^+-mesons with hydrogen nuclei, collected from various laboratories, are also presented. The angular distribution of the elastic scattering is compared with curves calculated by Costa and Patergnani for an optical model of the nucleus. The inelastic scattering data are, instead, compared with the results of a calculation performed with the Monte Carlo method, for a Fermi-gas nuclear model. Experimental evidence, such as the frequent occurrence of small angle elastic scatterings and the rarity of large energy losses, argue in favour of a repulsive nuclear potential acting on the K^+-meson. The angular distribution of the K^+–p collisions is then satisfactorily described assuming a predominant s-wave scattering for energies lower than ~ 50 MeV in the centre of mass system. The data on the K^+-nuclei inelastic scattering are shown instead to be well described, on the basis of the Fermi model, with the assumption that the K–nucleon cross-section is peaked backwards or is energy dependent. The influence of the two isotopic spin states which intervene in the K–nucleon scattering is discussed. A.

539.18 : 518.5

8874. MACHINE ANALYSIS OF PION SCATTERING BY THE MAXIMUM LIKELIHOOD METHOD. H.L.Anderson and W.C.Davidon.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1238-55 (May, 1957).

Reports the method used to carry out a phase-shift analysis of the pion–proton scattering events found in photographic emulsions and in the hydrogen diffusion-cloud-chamber. The method uses an electronic computer to find the best set of phase-shifts for a set of scattering events having a given energy, according to a maximum likelihood criterium. This problem was coded for the electronic computer, Avidac, of the Argonne National Laboratory, and used to analyse the events found by various groups of experimenters. Most of the results have already been reported. The analyses were carried out for positive pions scattered by protons and could include d-waves as well as s- and p-waves, together with the effect of the Coulomb interaction. A.

539.18

8875. ON THE ENERGY DISTRIBUTION IN THE ELASTIC SCATTERING OF K^+-MESONS BY NUCLEI. P.Mittelstaedt.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1480-96 (June, 1957). In German.

The energy distribution in the scattering by complex nuclei is calculated using the Goldberger method. The results are found to be in fair agreement with the 80 MeV experimental data of the Göttingen group. A.

539.18

8876. ON THE MEASUREMENTS OF THE PION–PROTON ELASTIC SCATTERING IN NUCLEAR EMULSIONS.
G.Ferrari, E.Manaresi and G.Quareni.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1651-7 (June, 1957).

The scanning methods for the photographic emulsions, used in the study of the pion–proton elastic scattering, are discussed. A particular method is described, which is useful in the research of backwards scattering ($135^0 < \theta_{c.m.} \leq 180^0$). It has been employed in order to detect some contribution of waves with $l > 1$, by analysing the behaviour of $d\sigma/d\Omega$ in this angular interval. The analysis of $d\sigma/d\Omega$ for the scattering process $\pi^+ + p$ at 120 MeV, based on 871 events, shows that no wave with $l > 1$ is present in a measurable quantity. The phase-shifts of the S and P waves result: $\alpha_3 = -10.3 \pm 2.9$; $\alpha_{33} = 31.8 \pm 1.6$; $\alpha_{31} = -2.6 \pm 1.6$. A

539.18

8877. π^+–PROTON SCATTERING AT 100 MeV.
R.Gessaroli, G.Quareni, G.Dascola, S.Mora and G.Todesco.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1658-9 (June, 1957).

The differential cross-section $d\sigma/d\Omega$ for the elastic process $\pi^+ + p$ at 100 MeV has been measured. 621 events were found in photographic emulsion. The phase-shift analysis gives the following values for the S and P waves: $\alpha_3 = -10.6 \pm 1.9$; $\alpha_{33} = 21.7 \pm 1.2$; $\alpha_{31} = -2.5 \pm 1.3$. A

539.18

8878. π^+-PROTON SCATTERING AT 83 MeV.
L.Ferretti, G.Quareni, M.Della Corte and T.Fazzini.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1660-2 (June, 1957).

In photographic emulsion 274 events $\pi^+ + p = \pi^+ + p$ have been found. The energy of the pions extends between 70 and 90 MeV; the mean energy is 83 MeV. The phase-shift analysis gives, for the S and P waves, the following values: $\alpha_3 = -12.3 \pm 2.9$; $\alpha_{33} = 12.0 \pm 2.2$; $\alpha_{31} = -3.1 \pm 1.0$. A

539.1

8879. THE NUCLEAR POTENTIAL FOR THE K^+-MESONS.
C.Marchi, G.Quareni, A.Vignudelli, G.Dascola and S.Mora.
Nuovo Cimento, (Ser. 10), Vol. 5, No. 6, 1790-2 (June, 1957).

Measurements were made of the differential cross-section for the elastic scattering of K^+-mesons with energies between 50 and 120 MeV in nuclear emulsions. For scattering angles between 3^0 and 26^0 the results are fitted by the optical model using a repulsive potential of $V_n = +10$ MeV and zero imaginary potential. A potential of $V_n = -22$ MeV is shown to give a comparatively poor fit. E.J.Burg

539.1

8880. INTERACTIONS OF K^+-MESONS WITH EMULSION NUCLEI BETWEEN 40 AND 160 MeV.
M.Baldo-Ceolin, M.Cresti, N.Dallaporta, M.Grilli, L.Guerriero, M.Merlin, G.A.Salandin and G.Zago.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 402-34 (Feb., 1957).

110 m of K^+ tracks have been followed in the energy interval from 40 to 160 MeV. The events observed have been classified (a) 5 K-H collisions; (b) 170 elastic and 91 inelastic scatterings; (c) 10 charge exchanges; (d) 56 decays in flight. The discrimination between elastic and inelastic scatterings has been made by a statistical method. The events have been divided in two energy intervals (40-90 MeV) and (90-160 MeV) in order to study the variation of the cross-section for elastic and inelastic events with energy. From the analysis of the elastic events the existence of a repulsive nuclear potential of about 15 MeV has been found. This result is in agreement with other features relative to inelastic events. From the analysis of the inelastic events some information about the elementary K-nucleon cross-section has been sought and at present the data seem to indicate that in the energy interval studied, the isotopic state T = 1 is predominant, probably as an S wave. In the higher energy interval there is probably a little contribution of a T = 0 state as a P wave. A

539.1

8881. K^- INTERACTIONS IN HYDROGEN. L.W.Alvarez, H.Bradner, P.Falk-Vairant, J.D.Gow, A.H.Rosenfeld, F.T.Solmitz and R.D.Tripp.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1026-46 (May, 1957).

K^--mesons from the Bevatron have been stopped in a 10 in. hydrogen bubble chamber. This is a preliminary report on the first 137 interactions. There are photographs confirming the existence of the $\overline{\theta}^0$ and the Σ^0, which must be lighter than the Σ^- by at least several MeV. Σ's are produced more profusely than Λ's in the absorption of K^- by protons: the production ratios being $\Sigma^- : \Sigma^+ : \Sigma^0 : \Lambda \cong 4 : 2 : 2 : 1$. The large observed absorption cross-section of slow K^- by protons suggests that the interaction takes place in p states as well as in s states. There is evidence that the spin of the Σ is greater than ½. There is no evidence for parity doublets. These data rule out the proposed selection rule $\Delta I = \pm ½$. The accepted value for the mean life τ_Λ is checked, giving $\tau_{\Sigma^-} = (1.83 \pm 0.26) \times 10^{-10}$ sec and $\tau_{\Sigma^+} = (0.86 \pm 0.17) \times 10^{-10}$ sec. A

539.18

8882. NUCLEAR INTERACTIONS OF NEUTRAL K-MESONS OF LONG LIFETIME. M.Baldo-Ceolin, C.C.Dilworth, W.F.Fry, W.D.B.Greening, H.Huzita, S.Limentani and A.E.Sichirollo.
Nuovo Cimento, Vol. 6, No. 1, 130-43 (July, 1957).

An emulsion stack was exposed to a neutral beam from the Berkeley Bevatron. The target to stack distance was 9.5 ft, which excluded θ_1-mesons from the stack. The plates were scanned for K^-, $\Sigma^\pm$ and hyperfragments which could have come from the nuclear interactions of the long-lived θ_2-meson. Five Σ^- and three Σ^+ hyperons have been found, all of which originated in small stars in the emulsions. In five cases the Σ hyperon was accompanied by a light meson, presumably a π-meson, each of which had an energy of less than 150 MeV. In two cases the mass of the incoming particle could be measured, and was found to be $(1000^{+\ 30}_{-180})$ m_e and $(995^{+\ 75}_{-270})$ m_e respectively. In addition, ten double stars with short connecting tracks have been observed which can be interpreted as hyperfragments. The production of the events in or near the stack by energetic nucleons, pions or K-mesons can be excluded. The events are interpreted as representing the nuclear interactions of long-lived θ_2-mesons in the $\overline{\theta}$ mode by the following reaction:

$$\theta_2 + \mathcal{N} \rightarrow \begin{pmatrix} \Sigma \\ \Lambda \end{pmatrix} + \pi.$$

A.

539.18

8883. EVALUATION OF NUCLEAR FUSION PROBABILITY IN MESIC MOLECULES. S.Gallone, G.M.Prosperi and A.Scotti.
Nuovo Cimento, Vol. 6, No. 1, 168-72 (July, 1957).

The binding energies of the mesic hydrogen-like molecular ions have been calculated together with the probability of nuclear fusion in the molecular ground state. A.

539.18

8884. ON THE INTERACTIONS OF FAST μ-MESONS. G.N.Fowler and A.W.Wolfendale.
Nuclear Physics, Vol. 3, No. 2, 299-306 (April, 1957).

The experimental and theoretical aspects of the production of stars and showers by fast μ-mesons are reviewed. Difficulties are encountered in explaining the increase in cross-section, with energy, for production of stars and showers with energy transfers of above about 400 MeV. These difficulties can be resolved if the Williams virtual photon method is assumed to be valid and if it is assumed that the photonuclear cross-section has further resonances above the π-meson resonance at about 300 MeV, corresponding to the production of heavy mesons or groups of π-mesons. A.

539.18

8885. THE ANNIHILATION OF A NUCLEON–ANTINUCLEON SYSTEM INTO A K–ANTI K PAIR. R.Gatto.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1024-5 (May, 1957).

The selection rules are derived for the annihilation of a nucleon–antinucleon system into a K–anti K pair. The selection rules follow from conservation of angular momentum, of parity, of the charge conjugation quantum number, and from charge symmetry. Moreover it is shown that, if the Lee–Yang parity doublets theory holds, other selection rules can be derived from the conservation of two new quantum numbers, E and F. A.

539.18

8886. THE PRODUCTION OF HEAVY MESONS AND HYPERONS BY π^--MESONS OF 4.5 GeV/c. B.P.Edwards, A.Engler, M.W.Friedlander and A.A.Kamal.
Nuovo Cimento (Ser.10), Vol. 5, No. 5, 1188-96 (May, 1957).

A systematic investigation has been carried out, using nuclear photographic emulsions, into the production of heavy unstable particles by π^--mesons of 4.5 GeV/c. From 2854 stars, 4 hyperons and 4 heavy mesons were found which had velocities of less than 0.7c, and which satisfied certain geometrical selection criteria. One hyperon produces a secondary π-meson which comes to rest in the emulsion stack. The mass of this hyperon, shown to be negatively charged by the nuclear capture of its secondary particle is (2352 ± 5) m_e. A.

539.18

8887. PARENT STARS OF K^+-MESONS. D.F.Falla, M.W.Friedlander, F.Anderson, W.D.B.Greening, S.Limentani, B.Sechi-Zorn, C.Cernigoi, G.Iernetti and G.Poiani.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1203-22 (May, 1957).

A study has been made of the parent stars of K-mesons produced by cosmic radiation. Emission angle and energy spectra are given for these mesons, together with a distribution of star sizes. An estimate is made of the frequency of occurrence of associated hyperons, other K-mesons and hyperfragments. Three particularly interesting events are described, including one which has enabled the mass, of the negative Σ-hyperon to be calculated as 2344 ± 6 m_e. A.

539.18

8888. MESON PRODUCTION BY A MESON NUCLEON COLLISION IN THE HEISENBERG REPRESENTATION. G.R.Screaton.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1398-410 (June, 1957).

A relation between the interaction operator, the Heisenberg operator and the interaction Hamiltonian is established. The matrix element for the production of mesons by a meson–nucleon collision is obtained with all its renormalization terms. A causality condition is shown to be involved in this matrix element. A.

539.18

8889. ON THE VISCOUS FLUID MODEL IN MULTIPLE PRODUCTION OF MESONS. M.Hamaguchi.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1622-35 (June, 1957).

The viscous effects in the hydrodynamical description of multiple production of particles in high energy collisions are discussed quantitatively. The multiplicity of the particles and the angular distribution (mean plateau) in the laboratory frame of reference are numerically calculated, and these results are compared with those obtained by Rozental et al. It is also shown that the viscous coefficients can be roughly estimated by comparison with experimental data. A.

539.18

8890. PHOTOPRODUCTION OF K MESONS FROM SINGLE NUCLEONS. M.Kawaguchi and M.J.Moravcsik.
Phys. Rev., Vol. 107, No. 2, 563-9 (July 15, 1957).

Perturbation calculations of the lowest order are carried out for K-meson photoproduction from single nucleons. Results are given for scalar and pseudoscalar mesons, with or without anomalous magnetic moments for the nucleons and hyperons, and with scalar, pseudoscalar, vector, and pseudovector couplings. Numerical results are given assuming unity for the coupling constant. The difference between the present results and those carried out for pion photoproduction is due to the mass difference of the nucleons and hyperons, the larger ratio of the meson mass to the nucleon mass, and the different values for the anomalous magnetic moments. The last of these effects is particularly striking and might be of practical significance when sufficient experimental information is available. A.

539.18

8891. PHOTOPRODUCTION OF K MESONS IN HYDROGEN NEAR THRESHOLD. A.Fujii and R.E.Marshak.
Phys. Rev., Vol. 107, No. 2, 570-2 (July 15, 1957).

The total cross-sections near threshold of the three processes: $\gamma + p \rightarrow \Lambda^0 + K^+$, $\Sigma^0 + K^+$, $\Sigma^+ + K^0$, have been calculated as a function of the incident photon energy in the laboratory system under the assumptions that the hyperons have spin $\frac{1}{2}^+$ with positive anomalous magnetic moments and that the K meson has spin 0_- and is coupled to the baryon field by direct Yukawa interaction. A pseudoscalar K meson gives a steep increase of the cross-section for neutral production and at the same time gives a large K^0/K^+ production ratio compared to that for a scalar K meson. A.

539.18

8892. PHOTOPRODUCTION OF NEUTRAL PIONS FROM HYDROGEN AT FORWARD ANGLES FROM 240 to 480 MeV. W.S.McDonald, V.Z.Peterson and D.R.Corson.
Phys. Rev., Vol. 107, No. 2, 577-85 (July 15, 1957).

Recoil protons from the process $\gamma + p \rightarrow p + \pi^0$ have been detected by nuclear emulsions placed within a hydrogen-gas target and used to measure the differential cross-section for production of neutral pions. In this manner protons of energies as low as 5 MeV can be detected at laboratory angles corresponding to emission of a pion at centre-of-momentum (c.m.) angles as low as 26°. This experiment thus supplements that of Oakley and Walker (Abstr. 4066/1955) which is in the same range of photon energies (240-480 MeV), but is restricted to pion c.m. angles greater than about 70° owing to higher minimum detectable proton energy. Common experimental points provide intercomparison of absolute values. Angular distributions are analysed in the form $d\sigma/d\Omega = A + B\cos\theta + C\cos^2\theta$ in the c.m. system. The combined Oakley–Walker and present data give the average value of the ratio A/C as -1.60 ± 0.10 in the energy range

from 260 to 450 MeV. The coefficient B, which gives the front-back asymmetry, passes through zero below the resonance energy of 320 MeV and is positive at higher energies. These results are consistent with magnetic dipole absorption leading to a state of the pion–nucleon system of angular momentum $\frac{3}{2}$, together with a finite amount of S-wave interference. A.

539.18

8893. ANGULAR DISTRIBUTION OF POSITIVE PION PHOTOPRODUCTION FROM HYDROGEN. M.J.Moravcsik.
Phys. Rev., Vol. 107, No. 2, 600-3 (July 15, 1957).

The analysis of all available data on the angular distribution of positive pions in photoproduction is carried out using a recently suggested method. The results are then compared with various theoretical predictions. It is shown that below resonance the various forms of the nonrelativistic theory give similar enough predictions so that present experiments could not distinguish among them. Above resonance the predictions diverge, and both the Low theory and the dispersional approach give surprisingly good agreement with data even at energies as high as 470 MeV. Below resonance the agreement with experimental data seems to be questionable, but more precise experiments are needed before definite conclusions can be drawn. It is also shown that the backward-to-forward ratio of the differential cross-section is sensitive to the contribution of the $P_{3/2}$, electric quadrupole state, and thus this ratio might become a good way of exploring the degree of enhancement of the electric quadrupole contribution. A.

539.18

8894. PHOTOPRODUCTION OF PIONS AT COMPLEX NUCLEI. E.W.Laing and R.G.Moorhouse.
Proc. Phys. Soc. A, Vol. 70, Pt 9, 629-38 (Sept., 1957).

The production of charged pions at complex nuclei is calculated on the basis of a simple independent particle model for the nucleus. The primary photoproduction is assumed to be a single nucleon process in which the struck nucleon undergoes transitions into discrete or continuum states. Two points of view are adopted, (a) that production may take place inside the nucleus; (b) that only surface production is allowed, according to the model of Wilson and of Butler. Cross-sections are obtained for two nuclei, B^{11} and Ca^{40}. Available experimental data is inconsistent with surface production. A.

539.185

8895. MEASUREMENT OF TOTAL CROSS-SECTIONS σ_t FOR E_n = 14.8 MeV NEUTRONS BY COUNTING (n,α)-COINCIDENCES. M.M.Khaletskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 2, 305-6 (1957). In Russian.

A thick T–Zr target was irradiated by 160 keV deuterons, an α-particle counter being placed on one side of it, and a neutron counter (in coincidence) on the other. A narrow beam of neutrons was isolated by counting (n,α)-coincidences from the reaction $D(T,n)He^4$. The cross-section σ_t was measured for Li, Be, C, Mg, Al, Fe, Cu, Pd, Cd, Sn, Pb, Bi, and U by counting coincidences with and without scatterers between the target and the neutron counter. The values obtained are in general agreement with those due to J.H.Coon et al. (Abstr. 1137/1953) and S.Goodman (Abstr. 1135/1953). S.Chomet

539.185

8896. DETERMINATION OF THE DIFFERENTIAL ELASTIC SCATTERING CROSS-SECTION FOR 14.8 MeV NEUTRONS BY COUNTING (n,α) COINCIDENCES. M.M.Khaletskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 3, 553-5 (1957). In Russian.

Cross-sections for Pb, Sn, Fe, Al and C are measured for neutrons obtained by the $D(T,n)He^4$ reaction. G.E.Brown

539.185

8897. FAST NEUTRON SCATTERING IN HELIUM IN THE ENERGY RANGE 2.61-4.09 MeV. H.R.Striebel and P.Huber.
Helv. phys. Acta, Vol. 30, No. 1, 67-84 (1957). In German.

Relative differential scattering cross-sections for neutrons on He^4 have been measured at nine neutron energies between 2.61 and 4.09 MeV. Using an ionization chamber the energy distributions of the recoiling He nuclei were observed with a 49-channel pulse-height analyser, which is briefly described. The wall effect was reduced to a few percent by using collimated neutrons, an anticoincidence method and by the addition of argon to the chamber gas. The cross-sections and the phase-shifts are in good agreement with the predictions from results of the p–He scattering. A.

539.185

8898. POLARIZATION IN NEUTRON PROTON SCATTERING AT 95 MeV. G.H.Stafford, C.Whitehead and P.Hillman.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1589-97 (June, 1957).

The free neutron–proton polarization has been measured at centre-of-mass angles from 20° to 160°. The asymmetries were obtained using fixed detectors and by rotating the plane of polarization of the neutron beam with respect to the scattering plane by means of a long solenoid. The polarization cross-section was found to be strongly non-antisymmetrical about 90° centre-of-mass and evidence for D-wave interaction was obtained. A.

539.185

8899. POLARISATION IN THE ELASTIC SCATTERING OF NEUTRONS BY HELIUM. R.E.White and F.J.M.Farley.
Nuclear Physics, Vol. 3, No. 3, 476-8 (May, 1957).

The polarization of neutrons in elastic scattering by helium is studied using polarized neutrons from a D–D source and observing the left-right asymmetry of recoil tracks in a helium-filled proportional counter. The polarization is 0.46 ± 0.18 for 3 MeV neutrons. A.

539.185

8900. THE PRODUCTION OF INTENSE COLD NEUTRON BEAMS. I.Butterworth, P.A.Egelstaff, H.London and F.J.Webb.
Phil. Mag. (Eighth Ser.), Vol. 2, 917-27 (July, 1957).

The moderation of pile neutrons to very low energies has been investigated. Liquid hydrogen, liquid hydrogen deuteride and methane at 20°K were found to be effective moderators. After an examination of the safety aspects, a volume of liquid hydrogen was maintained at the centre of a reactor, and the velocity spectrum of neutrons scattered from it was measured. Appreciable moderation of neutrons to very low energies was observed. By this method it is practicable to increase considerably the flux of cold neutrons in a beam. Thus, in the present experiment the flux of 10 A wavelength was increased by a factor of 25. A.

539.185.08

8901. THE MEASUREMENT OF FAST NEUTRON FLUX OVER THE NEUTRON ENERGY RANGE 0.03 MeV to 3.0 MeV. W.D.Allen and A.T.G.Ferguson.
Proc. Phys. Soc. A, Vol. 70, Pt 9, 639-53 (Sept., 1957).

Measurements of neutron flux in the neutron energy region 0.03 MeV to 3.0 MeV have been made using a proton recoil counter and a Hanson–McKibben type long counter. Several proton recoil counters filled with different gases at different pressures have given flux measurements self-consistent to 2%. The long counter has been calibrated against photoneutron sources at a number of energies and also against the recoil counter. The variation of its efficiency as determined by the two methods is in satisfactory agreement. The absolute calibration of the long counter with respect to a RdTh–D_2O source whose strength was known to ±2$\frac{1}{2}$% agreed with the calibration with respect to the recoil counter to 1%. A similar cross check with an Ra–Be source gave an initial discrepancy of 15% but this was traced to an error in the source strength and variation with energy in the response of the long counter. These cross checks are satisfactory and over the major portion of the energy range the standard error is not more than ±3%. A.

STRUCTURE OF SOLIDS 539.2

539.213

8902. THE DISTRIBUTION OF ATOMS IN STABLE AMORPHOUS AND LIQUID SELENIUM. H.Richter and F.Herre.
Naturwissenschaften, Vol. 44, No. 2, 31 (1957). In German.

Radial distribution curves show a strong resemblance between the atomic arrangements in these two cases. A.R.Stokes

539.217 : 533.1

8903. ON THE PERMEATION OF HYDROGEN AND HELIUM IN SINGLE CRYSTAL SILICON AND GERMANIUM AT ELEVATED TEMPERATURES. A.van Wieringen and N.Warmoltz.
Physica, Vol. 22, No. 10, 849-65 (Oct., 1956).

A mass spectrometer examination of the permeability of the elements silicon and germanium to the gases hydrogen and helium has been carried out in the temperature range 967-1207°C for silicon and 766-930°C for germanium. Using certain crystal growing and cutting techniques two kinds of diffusion cells were made by

each of which it was possible to determine both diffusion coefficient and solubility as well as the activation energies of diffusion and solution from non-steady-state permeation measurements. No permeation of the gases neon, argon and nitrogen could be detected. It seems that hydrogen in silicon can occur both in elemental form and as a compound. The elemental form diffuses easily and consists mainly of atoms or protons. A.

539.217

8904. ON THE DIFFUSION OF ANTIMONY AND TELLURIUM IN INDIUM ANTIMONIDE. B.I.Boltaks and G.S.Kulikov.
Zh. tekh. Fiz., Vol. 27, No. 1, 82-4 (1957). In Russian.

The following empirical formulae are derived for the diffusion coefficients (D) of In, Sb and Te respectively in InSb:

$$D_{In} = 1.8 \times 10^{-9} \exp(-0.28/kT)$$
$$D_{Sb} = 1.4 \times 10^{-6} \exp(-0.75/kT)$$
$$D_{Te} = 1.7 \times 10^{-7} \exp(-0.57/kT)$$

Extrapolation of the log D/T^{-1} curves gave the same values for all D at the melting point of InSb. A.F.Brown

539.217 : 537.311.33

AN ANALYSIS OF DIFFUSION IN SEMICONDUCTORS. See Abstr. 8603

539.219

8905. NUCLEAR MAGNETIC RESONANCE IN SOLID SOLUTIONS OF TRANSITION METALS IN COPPER AND ALUMINUM. T.Sugawara.
J. Phys. Soc. Japan, Vol. 12, No. 3, 309 (March, 1957).

Examples of the effect of paramagnetic metal impurities, Mn, Ni and Fe, on the line width, Knight shift and relaxation time of the nuclear resonance of the host metal, Cu or Al. D.H.Whiffen

539.219

8906. STACKING FAULTS IN FACE-CENTRED CUBIC METALS AND ALLOYS. R.E.Smallman and K.H.Westmacott.
Phil. Mag. (Eighth Ser.), Vol. 2, 669-83 (May, 1957).

Stacking faults on the (111) planes of several face-centred cubic metals and alloys have been introduced by cold work, and estimates of the stacking fault probability α, have been obtained from changes produced in the Debye–Scherrer spectrum. The faulting probability increases on alloying, from one plane 300 in copper, to one plane in 25 for some high solute content alloys containing zinc, aluminium, tin or germanium. Both neutron irradiation (5×10^{19} n.v.t.) and "quenched-in" vacancies have little significant effect on the faulting parameter. Lowering the temperature of deformation increases the faulting probability but in copper the faults "anneal-out" at room temperature after several hours. Line broadening analysis shows that the dislocation density is increased on alloying and also by lowering the deformation temperature. It is suggested that the faulting may be accounted for by the regions between separated half dislocations. Ribbons of stacking faults as given by extended dislocations and "infinite" stacking faults produced by splitting of dislocations at high stresses are both considered and estimates of fault energy made. Some work on segregation of solute atoms to faults is reported with particular reference to the alloys silver–gold and copper–aluminium. A.

539.219 : 548.7

LATTICE DISTORTION IN TERMINAL SOLID SOLUTIONS OF THE FIRST LONG PERIOD TRANSITION METALS AND COPPER. See Abstr. 8275

539.219 : 548.736.3

THE LATTICE SPACINGS OF NICKEL SOLID SOLUTIONS. See Abstr. 8292

539.234 : 548.74

STRUCTURE OF GERMANIUM FILMS PRODUCED BY VACUUM DEPOSITION. See Abstr. 8304

539.27

8907. IMAGES OF STRAINED METAL SAMPLES, OBTAINED WITH THE PHOTOEMISSION MICROSCOPE.
R.Bernard, C.Guillaud and R.Goutte.
J. Phys. Radium, Vol. 18, No. 5, 327-30 (May, 1957). In French.

The surface of stretched gold samples was studied by means of a photoemission microscope. After cleaning by ionic bombardment, the images show the crystalline structure well. The strain gives generally an increase of contrast. The area where strain is maximum (breaking zone) shows an increased brightness, probably owing to a local increase of the photoelectric emission factor. A.

539.27

8908. ELECTRON DIFFRACTION STUDY ON POLISH LAYERS OF GOLD. I. M.Kuriyama, K.Kohra and S.Takagi.
J. Phys. Soc. Japan, Vol. 12, No. 2, 151-6 (Feb., 1957).

Examination was made by the transmission method. Line breadths were measured at various stages of polishing. The mean grain size and the mean strain were determined using Hall's method (Abstr. 2492/1950) for medium polish layers which produce broad ring patterns. The grain size was also determined from the electron micrograph and from the number of spots on a spotty diffraction ring obtained from a minute region of the specimen. The values obtained from those different methods agree in order of magnitude with each other. Even at medium stages of polishing, the specimen is polished so heavily as to gain grain size 80 A and strain 3.6%. The grain size rapidly decreases as polishing proceeds. At the final stage of polishing broad ring patterns change into the halo pattern composed of three haloes. The Bragg spacing corresponding to the most inner halo is 4.08 A, agreeing with the results obtained by Nonaka and Kohra by the reflection method. A.

ELASTICITY. STRENGTH. RHEOLOGY

539.3/.8

539.32 : 534.2

INTERNAL FRICTION IN POLYMETHYL METHACRYLATE. See Abstr. 8469

539.374 : 548.7

8909. PHOTOELASTIC STUDY OF DISLOCATION ARRANGEMENTS IN CRYSTALS. J.F.Nye, R.D.Spence and M.T.Sprackling.
Phil. Mag. (Eighth Ser.), Vol. 2, 772-6 (June, 1957).

The plastic deformation of single crystal bars of silver chloride in tension and bending has been studied by using the photoelastic effect. It is found that in tension the plastic deformation is not uniform over a given cross-section but is greatest near the surfaces. In bending the plastic deformation is found to propagate longitudinally along the bars rather than transversely. The distribution of birefringence, and hence that of stress, has been measured and the result interpreted by means of a simple dislocation model. It is concluded that, in silver chloride, the ratio of the stress necessary to propagate dislocations to the stress necessary to generate them is less than about 0.6. The shear stress on the glide plane necessary to propagate dislocations is approximately 5.2×10^6 dynes/cm^2. A.

539.374

8910. THE FLOW STRESS OF POLYCRYSTALLINE ALUMINIUM. C.J.Ball.
Phil. Mag. (Eighth Ser.), Vol. 2, 1011-17 (Aug., 1957).

It is shown that there is a strong correlation between flow stress and subgrain size in polycrystalline aluminium deformed in tension; the strength of the boundaries does not appear to depend on boundary angle. The variation of flow stress with temperature suggests that the strength controlling factor is elastic interaction. A.

539.4 : 538.221

8911. ON THE VARIATION OF MAGNETIC AND MECHANICAL PROPERTIES OF IRON DUE TO DISSOLVED HYDROGEN.
A.Ferro and G.Montalenti.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 842-53 (April, 1957). In Italian.

The gas contained in the metal in solid solution tends to precipitate as diatomic molecules in elliptical cavities of a length of the order of at least several tens of atomic diameters thus giving rise to a strong pressure in the cavities themselves. This pressure can produce delayed breakage in the case of harder metals under an applied stress, and in the case of softer materials, the formation of blisters often visible by eye. These blisters are accompanied by rather large plastic slip which, as to magnetic properties, mainly increases the coercive force. The magnetic properties of hydrogen charged iron and cold worked specimens of the same material are compared. In both cases the same behaviour of coercive field versus annealing temperature has been found. Therefore the assumptions made receive further evidence. Moreover the average distance among hydrogen precipitation centres in iron is evaluated from the precipitation theory. The values obtained, ranging about 2×10^{-3} cm, are in agreement with the available experimental data. A.

539.4.01

8912. ON THE THEORY OF STRENGTH. S.D.Volkov.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 4, 632-5 (1957). In Russian.

The statistically derived condition of strength for brittle materials, such as thin-walled tubes made of gypsum (Zh. tekh. Fiz., Vol. 23, No. 11, 2025-38, 1953) is shown to be the natural generalization of the "first" theory of strength, based on the greatest normal tension stress, and to yield a better agreement with experimental results than the combination of any two of the classical theories of strength. This statistical condition of strength results in a set of equations with two parameters. A still better agreement with experiment is obtained if one allows for initial micro-stresses in the polycrystals; this involves the introduction of a third parameter. F.Lachman

539.42 : 548.7

8913. DISLOCATION LOCKING AND FRACTURE IN α-IRON. J.Heslop and N.J.Petch.
Phil. Mag. (Eighth Ser.), Vol. 2, 649-58 (May, 1957).

The inhibition of plastic deformation by dislocation locking promotes brittleness. The influence of manganese in iron is studied in detail and it is concluded that the ductility conferred by the manganese is associated with weakened dislocation locking as well as with grain refinement. The weakening of the locking appears to be due to interaction between nitrogen and manganese atoms. A.

539.434

8914. ON THE ACTIVATION ENERGY OF HIGH TEMPERATURE CREEP IN METALS. P.Feltham.
Phil. Mag. (Eighth Ser.), Vol. 2, 584-8 (May, 1957).

The temperature dependence of the activation volume or "stress-concentration factor" q appearing in the expression

$$d\epsilon/dt = A \exp(-H/kT) \sinh(q\sigma/kT)$$

relating the equilibrium tensile creep rate $d\epsilon/dt$, the temperature T and the applied tensile stress σ has been studied in the case of several pure metals subject to creep above about $\frac{1}{2}T_m$, where T_m is the melting point. On writing $q = nb^3$, where b is the distance of closest approach of atoms in the lattice, the relation

$$n = n_0 \exp\left[-\frac{Q}{kT}\left(1 - \frac{T}{T_m}\right)\right]$$

was found to be valid in all cases, with $Q = \alpha T_m$ and $\alpha = 4.9$ (cal/g atm)/°K, i.e. Q is equal to about twice the latent heat of melting. The increase of q with temperature is ascribed to the increase in the mean spacing between adjacent jogs in screw dislocations, and Q appears to be the activation energy for the conservative motion of jogs along dislocations. In face-centred cubic metals large values of n_0 are found to be associated with low stacking fault energies, and vice versa. A

539.62

8915. DIRECTION OF THE FRICTION FORCE. E.Rabinowicz.
Nature (London), Vol. 179, 1073 (May 25, 1957).

The author measures the transverse force F_t on a hemispherical steel slider loaded against a rotating steel disk with a dead load of 1000 g. Maximum $F_t = \mp 6$ g when slider crossing diagonally across lapping marks in early part of experiment reduces to random fluctuations of ∓ 2 g, after a few revolutions. These residual fluctuations are attributed to off-centre contact of asperities. (F_t/F_0) max. = 0.017 (where F_0 = frictional force in direction opposite to relative velocity) corresponding to fluctuations of 1° in direction of friction force. Measurements of F_t trace may be used (1) for studying rate of disappearance of systematic component of friction force, (2) for analysis by autocorrelation techniques without disadvantage of presence of large constant term in F_0 trace. J.W.Mente

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM. CHEMICAL REACTIONS 541.11/.12

541.124

8916. PROOF OF GIBERT'S RECIPROCAL RELATIONS FOR CHEMICAL SYSTEMS. A.Péneloux.
C.R. Acad. Sci. (Paris), Vol. 244, No. 17, 2238-41 (April 24, 1957). In French.

The relations are obtained, by non-statistical thermodynamical methods, in the form $\partial\nu_1/\partial A_2 = \partial\nu_2/\partial A_1$, where ν_1, ν_2 are the reaction rates and A_1, A_2 the affinities for two independent reactions taking place in the system. D.M.Edwards

541.126.4

8917. THE EFFECT OF SERIES RESISTANCE ON THE IGNITION OF METHANE-AIR GAS MIXTURES BY CAPACITIVE DISCHARGES. H.G.Riddlestone.
Rep. Brit. Elect. Res. Assoc., Rep. G/T304, 7 pp. (1956).

The effect of series resistance on the stored energy required to ignite 8.35% methane–air mixtures by capacitive spark discharges has been described previously (see Abstr. 3873/1953) for circuits in which the values of capacitance and resistance were less than 850 $\mu\mu$F and 60 ohms respectively. The range of the measurements has now been extended to include capacitances up to 1μF and resistances up to 225 000 ohms, with both tungsten and steel electrodes. Measurements of the actual discharge energies required for ignition with this increased range of circuit conditions has not yet been carried out, but the scope of the present techniques of oscillographic recording of the discharge currents and voltages is being widened to make this possible. A.

ELECTROCHEMISTRY 541.13

541.133.

8918. INSTRUMENTATION FOR HIGH-FIELD CONDUCTANCE MEASUREMENTS. F.R.Kotter.
Rev. sci. Instrum., Vol. 28, No. 3, 178-81 (March, 1957).

Improvements have been made in the differential pulse transformer bridge which increase its inherent precision by approximat an order of magnitude and extend its range to measurements with electrolytes of twenty times the concentration previously feasible. A circuit is described which permits study of the errors introduce by polarization and self-heating when electrolytic conductivity measurements are carried out with rectangular voltage pulses. Also described is an equipment for four-terminal resistance measurement with single-voltage pulses, which allows high-field conductance measurements free from errors caused by contact resistance, self heating, and space-charge accumulation; it has been applied to semiconductors.

541.135.4 : 539.21

8919. THE INTER-DIFFUSION OF TWO CHARGED PARTICLES (WITH PARTICULAR REFERENCE TO ION-EXCHANGE IN ZEOLITES). I.R.Beattie and D.R.Davies.
Phil. Mag. (Eighth Ser.), Vol. 2, 599-606 (May, 1957).

The general importance of ion exchange is mentioned, together with the work of previous investigators. The mechanism whereby two ions may change places is examined, and it is concluded that in many cases two ions diffusing in opposite directions in a charged substrate will diffuse independently of one another apart from any space charge effects. An equation is developed relating the amoun

of material exchanged during a reaction with the square root of the duration of the experiment. Practical applications of this equation are briefly discussed, as is the effect of immiscibility of solid solutions within the exchanger. A.

PHOTOCHEMISTRY. RADIATION CHEMISTRY 541.14/.15

541.14

8920. PHOTOCHEMICAL STUDIES IN FLASH PHOTOLYSIS. I. PHOTOLYSIS OF ACETONE. G.K.Oster and R.A.Marcus.
J. chem. Phys., Vol. 27, No. 2, 472-5 (Aug., 1957).

The high-intensity flash photolysis of acetone was investigated using an exploding wire as a light source. Experiments were conducted with the unfiltered light of the flash, containing light in the near as well as in the far ultraviolet region of the spectrum. The results show that the C_2H_6/CO ratio in the reaction products is about 1.25 and is fairly insensitive to variation in acetone pressure. Addition of small amounts of biacetyl lowers the ratio still further. This is attributed to the deactivation of a long-lived excited acetone molecule formed in the ultraviolet region below 210 mμ. Addition of butane lowers the ratio far below unity. The CH_4/CO ratio has the constant value of 0.1 for various light intensities, acetone pressures, pressures of added butane or of carbon dioxide. A convenient way of separating small amounts of ethane from very large amounts of carbon dioxide is described. A.

541.15

8921. A STUDY OF SZILARD–CHALMERS EFFECT ON BROMIDE COMPOUNDS. I. CHEMICAL FORMS OF RADIOACTIVE BROMINE OBTAINED THROUGH SZILARD–CHALMERS EFFECT ON POTASSIUM BROMATE.
R.Henry, C.Aubertin and E.de la Guéronnière.
J. Phys. Radium, Vol. 18, No. 5, 320-2 (May, 1957), In French.

After studying the changes in retention in potassium bromate that appear after irradiation at different fluxes, the authors have tried to find the reason for these changes. Radioactive bromine is partially oxidized (bromite or hypobromite). Changes in chemical behaviour at different fluxes of irradiation are tentatively assigned to changes in the concentration of these recoil species. A.

DISPERSIONS. COLLOIDS. ADSORPTION 541.18

541.182.3 : 778.31

8922. A PHOTOGRAPHIC METHOD OF ANALYSING AEROSOLS. J.F.Richardson and E.R.Wooding.
J. photogr. Sci., Vol. 4, No. 3, 75-8 (May-June, 1956).

The variation in size and concentration of particles in an aerosol over short periods of time has been determined by a photographic technique in conjunction with a slit ultramicroscope. The method has been found satisfactory for particle diameters between 0.2 and 4 microns and concentration up to 10^7 particles per cm^3. Some of the disadvantages of the ultramicroscope have been overcome and the accuracy and reliability of the results have been assessed. A.

541.183.26

8923. ISOTOPIC EFFECTS IN THE ADSORPTION OF GAS ON A SOLID. P.Caldirola and G.Rossi.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1316-32 (May, 1957). In Italian.

The isotopic effects which appear in the adsorption process of a gaseous mixture on a solid surface are studied basing on the theory of Lennard-Jones on the interaction of atoms and molecules with solid surfaces. The formulae deduced for a mixture of two generic isotopic species have been applied to the special case of the adsorption of helium (He_2^3 and He_2^4) on lithium fluoride. It was found that on the adsorbent surface the isotopic enrichment δ_{ads} in stationary conditions is always inferior to the enrichment δ_k of Knudsen, which is characteristic of the diffusion phenomenon, approaching it with rising temperature. A.

CHEMICAL ANALYSIS 543/545

545.37

8924. MECHANISM OF POLARIZATION IN THE POLAROGRAPHY OF SIMPLE IONS OF NICKEL AND COBALT. Ya.I.Tur'yan.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 3, 631-4 (1957). In Russian.

From a study of the polarization of nickel and cobalt at a dropping mercury cathode in solutions of their nitrites, perchlorates, and sulphates at various current densities it is concluded that the "irreversibility" of the polarographic waves of ions of these metals is due to inhibition of their discharge. R.C.Murray

CRYSTALLOGRAPHY 548

548.0 : 531.259

THERMAL STRESSES IN CRYSTALS. See Abstr. 8443-5

548.3

8925. PREPARATION OF $BaTiO_3$ SINGLE CRYSTALS IN COAL GAS ATMOSPHERE. K.Kawabe and S.Sawada.
J. Phys. Soc. Japan, Vol. 12, No. 2, 218 (Feb., 1957).

A stoichiometric mixture of TiO_2 and $BaCO_3$ with Na_2CO_3 as flux was heated to 1200°C in a Ni crucible in a coal-gas atmosphere. Thin-plate like crystals of $BaTiO_3$ (20-30μ thick, 1 cm long) were obtained, with a Curie temperature of 118°C. With KF as flux and a final heat treatment in air, light brown crystals were obtained with a Curie temperature of 122°C. J.Franks

548.5 : 539.23

8926. THE INITIAL STAGES OF GROWTH OF THIN METAL FILMS ON A SILVER SINGLE-CRYSTAL SUBSTRATE.
R.C.Newman.
Phil. Mag. (Eighth Ser.), Vol. 2, 750-60 (June, 1957).

Very thin layers of several metals have been deposited on smooth (111) surfaces of silver single crystals. The initial stages of growth of these deposits were followed by electron diffraction. Lead, thallium and silver grew in the form of oriented monolayers, while three-dimensional crystallites of gold and nickel were found in the earliest detectable stages. Thin deposits up to about 8 A of both tin and antimony possessed an amorphous structure only. Spontaneous crystallization of these films was observed and thicker films were wholly crystalline. In several cases a proportion of randomly oriented deposit was formed which predominated when the thickness of the film was increased. This shows the importance of examining the initial stages of the process. No evidence for pseudomorphic growth was observed. A.

548.5

8927. ORIENTED GROWTH AND DEFINITION OF MEDIUM ANGLE SEMICONDUCTOR BICRYSTALS.
H.F.Mataré and H.A.R.Wegener.
Z. Phys., Vol. 148, No. 5, 631-45 (1957).

The physical and metallurgical procedure in the preparation of semiconductor bicrystals is described, methods of seed orientation are given and precision limits are discussed. It is shown that medium-angle boundaries can be grown at a high precision if proper techniques are used. A number of microphotographs of grown grain boundary structures is given. A.

548.523

8928. A STUDY OF THE GROWTH OF CRYSTALS FROM SOLUTION WHEN SUBJECTED TO LOCAL DEFORMATION.
A.P.Williams.
Phil. Mag. (Eighth Ser.), Vol. 2, 635-8 (May, 1957).

The effect of local deformation on the growth features on

crystal faces has been studied on crystals of lead nitrate and potassium di-hydrogen phosphate. New growth centres form at these points and these can be initiated where desired on the face and if strong enough will dominate over the existing centres of growth. This can be done repeatedly, and it is suggested as a possible method for controlling flawed regions in artificially grown crystals. A.

548.57 : 541.64

8929. A NOTE ON SINGLE CRYSTALS IN POLYMERS: EVIDENCE FOR A FOLDED CHAIN CONFIGURATION. A.Keller.
Phil. Mag. (Eighth Ser.), Vol. 2, 1171-5 (Sept., 1957).

The morphology and orientation of a number of polymers as crystallized from solution was studied with the electron microscope combined with selected area electron diffraction. In the course of this work single crystals could be prepared which were most striking in the case of straight chain polyethylenes. There is evidence among others, that the fibrillar (sheaf-type, spherulitic) crystallization, characteristic of polymers, develops through formation of flat single crystals. The single crystals contain screw dislocations and grow by spiral terraces. The observed orientation and the minimum thickness of the crystals leads to the inescapable conclusion that the molecules must bend sharply back on themselves forming a regular folded configuration. Accordingly the strength of the dislocation, consequently the height of growth step, would correspond to the distance between successive ends. Various other observations are consistent with this new concept. A.

548.57 : 537.311.33

PRODUCTION OF SINGLE CRYSTALS OF SILICON BY PULLING FROM MELT. See Abstr. 8625

548.574

8930. THE ETCHING OF DIAMONDS BY LOW PRESSURE OXYGEN. M.Omar and M.Kenawi.
Phil. Mag. (Eighth Ser.), Vol. 2, 859-63 (July, 1957).

Diamonds have been etched by heating on a molybdenum filament in a low pressure (about 2.5 μ Hg) of oxygen. The etch figures obtained by this method have the same orientation as those obtained by etching in oxidizing melts, but differ in outline by being sharply triangular. They are in fact similar in all respects, except for the inverted orientation, to the natural features called "trigons". It is therefore concluded, contrary to recently accepted opinion, that the latter are also probably etch figures, produced by an unknown natural etching process. It is noted that unless the edge of the crystal is in the field of view, all upright triangles are etch pits. A.

548.574

8931. RECTILINEAR ETCH PITS ON DIAMOND.
S.Tolansky and A.R.Patel.
Phil. Mag. (Eighth Ser.), Vol. 2, 1003-5 (Aug., 1957).

It is established that the rectilinearity of the pits formed by etching octahedral faces of diamond depends in a sensitive manner on the temperature and rate of etch. Etching in potassium nitrate at 475°C, although slow, produces rectilinear pits. At 525°C etching is much faster and the pits round off in the familiar manner already long known. A.

ATOMIC AND X-RAY CRYSTALLOGRAPHY

548.7

548.7

8932. THE CALCULATION OF LATTICE CONSTANTS IN CRYSTAL STATISTICS. C.Domb and M.F.Sykes.
Phil. Mag. (Eighth Ser.), Vol. 2, 733-49 (June, 1957).

Discusses systematic methods of evaluating and checking certain lattice constants which arise in cooperative phenomena associated with crystal lattices. Many of these constants have been evaluated previously, but little systematic description of methods used exists in the literature, and there are discrepancies between results obtained by different authors. Several new suggestions are put forward, the most important being the use of a "no immediate return" random walk problem, and the use of finite close-packed clusters for checking the evaluations. A.

548.7 : 538.114

8933. A SUMMATION METHOD FOR CRYSTAL STATISTICS. D.Park.
Physica, Vol. 22, No. 10, 932-40 (Oct., 1956).

A method is given for summing the high- and low-temperature expansions which come out of calculations on crystal statistics. If the series represents an algebraic function of sufficiently transparent structure, it may be summed exactly, otherwise various degrees of approximation result. It is always possible to establish whether the function is algebraic even if it cannot be summed exactly provided that enough terms of the series are available. The procedure is applied to evaluate the spontaneous magnetization of square and cubical Ising lattices, and also to find approximate expressions for the initial susceptibility of the ferromagnetic and antiferromagnetic square lattices. A.

548.7

8934. ON THE CALCULATION OF LATTICE SUMS. B.R.A.Nijboer and F.W.de Wette.
Physica, Vol. 23, No. 4, 309-21 (April, 1957).

A short and straightforward method for the conversion of slowly converging lattice sums into expressions with good convergence is presented. As an illustration a well-known expression for the Madelung constant is rederived. The method is then applied to two general types of lattice sums, the latter of which has not been treated before. A.

548.7

8935. X-RAY MICROGRAPHY AND THE STRUCTURE OF IMPERFECT CRYSTALS. I. THE GEOMETRY OF THE MOUNTING. A.Merlini and A.Guinier.
Bull. Soc. Franç. Minéral. Crist., Vol. 80, No. 4-6, 147-57 (April-June, 1957). In French.

The reflection of X-rays from a crystal surface provides a method for the study of crystal imperfections, in particular the disorientation of crystal planes and variation in their reflecting power. This paper describes an arrangement using monochromatic X-rays which is a development of the Berg and Barrett use of this method. The resolving power is calculated. A.B.Lidiard

548.7

8936. IRRADIATION DAMAGE IN SINGLE CRYSTALS OF MAGNESIUM OXIDE. F.P.Clarke.
Phil. Mag. (Eighth Ser.), Vol. 2, 607-27 (May, 1957).

Single crystals of magnesium oxide have been subjected to ultraviolet X and neutron irradiation. The bands produced by these radiations, their optical and thermal bleaching and associated luminescence are discussed. Taking into account the data of other workers, schemes for ultraviolet activation and luminescence are proposed. The ultraviolet activation is attributed to the freeing of positive holes, perhaps with exciton formation as an intermediary process, and the subsequent trapping of both electrons and positive holes at negative and positive ion vacancies. The role of the various impurities is discussed and it is concluded that they do not directly give rise to the optical absorption bands observed. The luminescence scheme assumes an optical band width of over 7.0 eV. It is then shown that the various luminescence photon energies correspond to values which are to be expected on the assumption that the optical absorption energies represent the heights of bands measured from the top of the valence band. A.

548.

8937. SURFACE DISTRIBUTIONS OF DISLOCATIONS IN METALS. II. C.J.Ball.
Phil. Mag. (Eighth Ser.), Vol. 2, 977-84 (Aug., 1957).

For previous part, see Abstr. 2545 (1956). It is shown that the rotation axis of a boundary containing dislocations of three systems can lie anywhere on the surface of a cone; to each direction of the rotation axis there corresponds a single boundary plane. The theory cannot explain the experimental evidence on misorientations in zinc unless slip occurs in non-basal directions, or on planes not hitherto reported, at high temperatures. The experimental evidence for face-centred cubic metals is insufficiently precise to form a test of the theory. A.

548.7

8938. AN X-RAY STUDY OF NEUTRON IRRADIATED LITHIUM FLUORIDE. R.E.Smallman and B.T.M.Willis.
Phil. Mag. (Eighth Ser.), Vol. 2, 1018-26 (Aug., 1957).

The nature of the damage in neutron irradiated lithium fluoride has been examined by X-rays up to neutron doses at which the majority of the ions have been displaced from their lattice sites.

The observations were made by Debye–Scherrer powder photography, Laue photography and small-angle scattering. The results indicate that isolated defects predominate at low doses, but that these cluster to form large defects at doses higher than about 10^{17} neutrons/cm^2. With the exception of some small-angle scattering all the X-ray effects anneal out in the range 400°-500°C. This residual scattering is interpreted as that associated with gas bubbles. A.

548.7

8939. AN ELECTRON MICROSCOPIC STUDY OF PRECIPITATED SILVER IN SILVER ACTIVATED ROCKSALT CRYSTALS.
W.Maenhout-van der Vorst, W.Dekeyser and A.Lagasse.
Physica, Vol. 23, No. 7, 657-62 (July, 1957).

Dislocations in silver activated rocksalt crystals were decorated by heating them in a hydrogen atmosphere. The so formed silver precipitates have been studied by ultra and electron microscopy. Flat monocrystalline silver flakes extended along (111) planes which lie parallel to the (111) planes of the rocksalt have been found as well as shapeless agglomerates and irregularly filled tubes. These results confirm views expressed by Mitchell, and by Coulomb and Friedel concerning the segregation of vacancies at dislocation lines. Some of the shapeless precipitates exhibit a curious phenomenon when heated just under the melting point by the electron beam: material is suddenly extruded as a loosely wound helicoidal wire. A.

548.7

8940. COLOUR CENTRES IN ALKALI HALIDES.
D.Saint-James.
J. Phys. Radium, Vol. 18, No. 4, 260-79 (April, 1957). In French.

The main experimental results in the field of colour centres are summarized and described. Use has been made of a paper by F.Seitz, which is supplemented from publications after 1954. Different kinds of models have been proposed to account for the experimental observations; they are discussed, and an attempt is made to separate out those which could be definitely adopted. A number of theoretical calculations, mostly about F-centres, are summarized. A.

548.7

8941. THE KINETICS OF COLOUR CENTRE FORMATION IN QUARTZ. E.G.S.Paige.
Phil. Mag. (Eighth Ser.), Vol. 2, 864-76 (July, 1957).

It is shown that when free carriers are generated in a solid containing two or more types of defect capable of trapping electrons or holes, the occupancy of one type of trap is not, in general, a simple irradiation time dependent function of the form $1-\exp(-t/\tau)$ but is dependent on the parameters of the other traps and at saturation can be significantly less than unity. Using a model for crystalline quartz it is possible to explain radiation bleaching by both X-rays and neutrons, by considering the dependence of the occupancy of one trap on other traps. With the same model an explanation of the effect of heat treatment on the kinetics of coloration observed by Forman (1951) is given. From a quantitative comparison between the predicted and observed rate curves of an X-ray irradiated crystal, f-values and defect concentrations are calculated. Less detailed comments are made on the coloration of fused quartz. A.

548.7

8942. EFFECT OF BLEACHING ON THE OPTICAL BAND WIDTH OF THE F CENTER IN KCl. J.D.Konitzer and J.J.Markham.
Phys. Rev., Vol. 107, No. 3, 685-6 (Aug. 1, 1957).

Measurements have been made of the absorption of the F region in KCl at 78°K. It has been found that the structure in this region is dependent on the presence of the M, N, R, and K bands. The broadening in the presence of small amounts of M absorption indicates that it is not simply due to the overlapping of R, M, and N bands but is caused by an additional structure. These measurements support the present interpretation of the work of Van Doorn and Haven (Abstr. 2788/1956); they can explain the difference in the measurements of Pick and Geiger as well as the difference in the half-width observed by Mollwo and more recent data. A.

548.7

8943. THE GEOMETRY OF GRAIN BOUNDARY JUNCTIONS.
S.Amelinckx.
Physica, Vol. 23, No. 7, 663-92 (July, 1957).

Boundaries which can be built from two sets of dislocation lines are deduced in a general way. Explicit formulae for the densities of dislocations in each set are derived and the results are applied to the sodium chloride structure. The possibilities of joining three of these nets along a nodal line are investigated and the geometry of these junctions is discussed. Relations are also found between densities of emergence points along the three boundaries of a junction. Finally the conditions under which four nodal lines can meet in one point are discussed; this last configuration is the main feature in building up the cellular structure of a crystal. A few observed examples of boundary junctions are also presented. A.

548.7 : 536.413

INFLUENCE OF VACANCIES ON THE THERMAL EXPANSION OF LEAD NEAR THE MELTING POINT. See Abstr. 8557

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.73 : 538.566

8944. MICROWAVE MODEL CRYSTALLOGRAPHY.
J.F.Ramsay and S.C.Snook.
Electronic Radio Engr, Vol. 34, No. 5, 165-9 (May, 1957).

The X-ray beam was represented by 8.7 mm waves from a klystron generator, the crystal structure by an array of parallel dielectric rods, and the detector by a crystal diode. The apparatus and its performance are described, but not in detail. A.R.Stokes

548.735

8945. GENERAL RELATION BETWEEN LATTICE SUMS.
J.K.Mackenzie.
J. chem. Phys., Vol. 26, No. 6, 1769 (June,1957).

The formulae of Benson (Abstr. 7840/1956) and van Zeggeren (Abstr. 7494/1957) for the Madelung constants of ionic crystals are shown to be special cases of a general relation between lattice sums. A.B.Lidiard

548.736.1

8946. THE LATTICE CONSTANTS OF THE INERT ELEMENTS.
G.H.Cheesman and C.M.Soane.
Proc. Phys. Soc. B, Vol. 70, Pt 7, 700-2 (July, 1957).

An account of an X-ray determination of the lattice constants of Xe and Kr, undertaken as part of an investigation that was not completed. The apparatus will be described in detail elsewhere; but the results are:

Xe	$a = 6.185 \pm 0.002$ kX at 58°K
	$a = 6.206 \pm 0.003$ kX at 77.4°K
	$a = 6.216 \pm 0.004$ kX at 88.9°K
Kr	$a = 5.710 \pm 0.003$ kX at 58°K
	$a = 5.734 \pm 0.01$ kX at 68°K

J.Thewlis

548.736.4

8947. POLYNUCLEAR METAL CARBONYLS. I. STRUCTURES OF $Mn_2(CO)_{10}$ AND $Re_2(CO)_{10}$. L.F.Dahl, E.Ishishi and R.E.Rundle.
J. chem. Phys., Vol. 26, No. 6, 1750-1 (June, 1957).

From diffraction data, both $Mn_2(CO)_{10}$ and $Re_2(CO)_{10}$ have approximately D_{4d} symmetry with direct metal–metal bonds and no bridge carbonyls. Each metal atom is octahedrally coordinated with carbonyl groups and the other metal atom, the observed metal–metal bond being much greater than the covalent bond distances. G.I.W.Llewelyn

548.736.4

8948. POLYNUCLEAR METAL CARBONYLS. II. STRUCTURE OF IRON TETRACARBONYL BY X-RAY DIFFRACTION.
L.F.Dahl and R.E.Rundle.
J. chem. Phys., Vol. 26, No. 6, 1751-2 (June, 1957).

For Pt I see preceding abstract. Complete three-dimensional Patterson sections do not permit iron atom positions based on a linear trimer but suggest a regular hexagon of iron atoms. G.I.W.Llewelyn

548.737

8949. ON THE STRUCTURE OF GLYOXIME IN THE SOLID STATE. M.Milone and E.Borello.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 562-71 (March, 1957).
In Italian.

Preliminary results from X-ray analysis and infrared spectroscopy are reported. The study of the infrared spectra in the solid state suggests a centrosymmetrical structure for the glyoxime and the symmetry group C_{2h}. Hydrogen bonds are present. Glyoxime crystallizes with the following crystallographic constants: $\alpha = \gamma = 90°$, $\beta = 88°30'$, a = 3.88 A, b = 4.45 A, c = 11.08 A, and two molecules in the unit cell. From the systematics of the reflections it is concluded that glyoxime crystallizes in the spatial group C_{2h}^5 with x, y, z; $\bar{x}$, $\bar{y}$, $\bar{z}$; x, $\frac{1}{2}$ + y, $\frac{1}{2}$ − z; x, $\frac{1}{2}$ − y, $\frac{1}{2}$ + z, as

coordinates of the equivalent positions. Each molecule in the unit cell must, therefore, occupy two equivalent positions and is then centrosymmetric. (100) is a cleavage plane and then the molecules lie in the y, z plane. Examination with polarized infrared radiations of thin crystalline plates, cut parallel to (100) showed parallel dichroism for the OH and C=N stretching vibrations and perpendicular dichroism for the NO stretching vibration. Probably the C–C bond in glyoxime presents only a little bending on the crystallographic axis c and the molecules form long chains parallel to the axis b. A.

548.74

8950. ELECTRON DIFFRACTION FROM CRYSTALS CONTAINING STACKING FAULTS. I. M.J.Whelan and P.B.Hirsch.
Phil. Mag. (Eighth Ser.), Vol. 2, 1121-42 (Sept., 1957).

The dynamical theory of electron diffraction is applied to the case of a plate-like crystal containing a stacking fault. The effect of the fault is to produce a phase difference in the electron waves diffracted by the two parts of the faulted crystal. Expressions for the wave-functions and for the corresponding intensities, predicting interference fringes in the region of overlap of the two parts are derived. It is shown that the problem is one of the interference of three coherent waves, in contrast to the case of the wedge crystal where only two waves are involved. At the Bragg reflecting position the spacing of the fringes is half that corresponding to the extinction distance in the crystal. At large deviations from the Bragg position the predictions of the dynamical theory are asymptotic to those of the kinematical theory. The case of two or more stacking faults on neighbouring atomic planes is also considered. A.

GEOPHYSICS 55

ATMOSPHERE. METEOROLOGY 551.5

551.510.535

8951. THE EFFECT OF THE EQUATORIAL ELECTROJET ON THE IONOSPHERIC E_S AND F2 LAYERS.
N.J.Skinner and R.W.Wright.
Proc. Phys. Soc. B, Vol. 70, Pt 9, 833-9 (Sept., 1957).

It is found at Ibadan that during the daylight hours fE_S is lower on magnetically disturbed days than on quiet days. It is also found that on two or three occasions in each month a series of abnormally low values of fE_S occurs. An investigation of the behaviour of the horizontal and vertical components of the earth's field during these times reveals that there is a simultaneous decrease in the magnitude of the equatorial electrojet current which is in turn responsible for the large diurnal ranges in H and Z near the equator. The behaviour of the F2 layer parameters f_oF2, y_mF2 and h_mF2 during periods of low fE_S, shows that the F2 layer always becomes denser, lower and thinner during these periods. This indicates an immediate connection between the electrojet, the production of equatorial E_S and vertical drifts in the F2 layer. A.

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.521.326 : 535.241.39

STANDARD OF LOW LUMINANCE FOR STUDYING THE LIGHT OF THE NIGHT SKY. See Abstr. 8500

551.593 : 535.43

NON-MOLECULAR SCATTERING IN THE UPPER LAYERS OF THE ATMOSPHERE. See Abstr. 8542

BIOLOGY 57/59

MEDICAL SCIENCE. HUMAN PHYSIOLOGY 61

612.843.31

8952. NATURE OF THE COLOUR VISION OF ANOMALOUS TRICHROMATS. N.V.Lobanova.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 4, 552-5 (1956). In Russian.

Kries's method of checking the validity of the assumption that a special pigmentation exists in the eye of an anomalous trichromat was later successfully utilized by Yustova (Dokl. Akad. Nauk SSSR, Vol. 81, No. 6, 1051, 1951) who checked experimentally the theoretical relationship between the trichromatic coordinates (a,b,c) of a certain spectral emission in the case of anomalous and those (a_o, b_o,c_o) in the case of normal trichromats. The author confirmed Yustova's finding for artificial anomalous trichromats (in agreement with the special pigmentation assumption) that the ratios $b'/a' : b_o/a_o$ and $c'/b' : c_o/b_o$ are constant for all colours of the spectrum. The author describes in detail tests conducted with 4 deuteranomalous subjects, and concludes that their anomaly cannot be explained by pigmentation; that results of tests show that deuteranomalous subjects are characterized by a change in the spectral characteristic of sensitivity in only one receptor. F.Lachman

612.843.31

8953. COLOUR DISTINCTION IN ANOMALOUS TRICHROMATS. G.N.Rautian.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 1, 92-3 (1956). In Russian.

Presents the results of measurements of the colour distinction thresholds for different colours (in the form of threshold ellipses), for a normal trichromat as well as for different anomalous trichromats. The apparatus used was a double trichromatic colorimeter described in a previous paper (Dokl. Akad. Nauk SSSR, Vol. 92, No. 5, 943, 1953). The results confirm that original idea of Rayleigh, viz. that the anomaly is a kind of colour vision, independent of the level of the acuity of colour distinction. The system of colour determination in an observer with anomalous colour distinction is, in general, not related to that possessed by a normal trichromat. The ellipses obtained should be considered as representations, in the chromaticity-graph plane, of the threshold colour inequalities for the anomalous subjects, as they are seen by a normal eye. The coefficients of anomaly (n_A) obtained by means of the GOI anomaloscope (Rautian, Dokl. Akad. Nauk SSSR, Vol. 73, No. 1, 99, 1950) for the protanomalous and deuteranomalous trichromats form fairly homogeneous groups of typical anomalous trichromats. However, even for very close values of n_A, the threshold ellipses can vary within wide limits F.Lachman

612.843.3

8954. COLOUR DISCRIMINATION OF POINT SOURCES. G.N.Rautian and M.K.Gur'eva.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 6, 1037-40 (1957). In Russian.

By using a previously described double trichromatic colorimeter (Dokl. Akad. Nauk SSSR, Vol. 92, No. 5, 945, 1953), the authors determined directly, in terms of thresholds, the differences between colours for a series of point signals, and found the relationship between the acuity of colour distinction and (1) the angle distance between the sources and (2) their light intensity estimated by the illumination of the observer's pupil. Five colours (red, green, blue, white and yellow) and points with angular dimensions 1-10' were investigated. It was found that, in the range 2-10', the size of the source does not affect the acuity of colour distinction. In the illumination range 8×10^{-5}-4×10^{-7} luxes the number of thresholds (between two colours) depends linearly on the logarithm of illumination. As far as the distance between the sources is concerned, the acuity of colour distinction has a faint maximum for a distance of 1°, this maximum almost flattening out in the case of a small number of thresholds (e.g., white-yellow). F.Lachma

612.843.367 : 628.9

8955. EVALUATION OF GLARE. R.G.Hopkinson.
Illum. Engng, Vol. 52, No. 6, 305-16 (June, 1957).

The results of a number of researches on glare index are discussed and compared. The limitations to the validity of the formulae used are mentioned, in particular the breakdown at extremes of luminance and departures from additivity in the effects of a number of glaring sources. The glare index formula used at the Building Research Station is $G = B_s^{2n}Q^n/B_b$ where B_s and Q are respectively the luminance and apparent size of the source, B_b is the adaptation luminance and n = 0.8. There is a projection network for obtaining conveniently the combined effect of the size and position of the source. J.W.T.Walsh

612.85

8956. NOISE MASKED THRESHOLDS AS A FUNCTION OF TONAL DURATION AND MASKING NOISE BAND WIDTH. P.M.Hamilton.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 506-11 (April, 1957).

Noise masked thresholds for 800 c/s tonal pulses 25 to 400 msec long were measured in masking noise bands from 19 to 1100 c/s wide. It was found that the threshold remained constant for equal values of band-width, pulse-length product. The threshold varied according to a previously proposed formula: $S/N = m/BT^{0.8}$, where S is the signal power, N is the noise power in the pass-band of the filter, B is the band-width, T is the pulse length, and m is a constant. A.

612.85

8957. SIGNAL DETECTION AS A FUNCTION OF SIGNAL INTENSITY AND DURATION.
D.M.Green, T.G.Birdsall and W.P.Tanner, Jr.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 523-31 (April, 1957).

The object of this study was to determine how signal amplitude and duration effect the detectability of a pure tone partially masked by random noise. If signal duration and amplitude are considered two dimensions in a space, the study attempted to determine the surface of detectability in this space. To accomplish this task three experiments were conducted with the same observers in each experiment. In the first experiment signal duration was held constant while amplitude was varied. In the second experiment signal energy was held constant while various pairs of values of signal duration and amplitude were tested. Finally, signal amplitude was held constant while signal duration was varied. A three-parameter equation was determined which provided a reasonable fit to this surface of detectability in the plane of signal amplitude and duration. The equations are consistent with the data of previous research. Finally, a comparison of the results and the predictions generated by a simple filter model is discussed. A.

612.858

8958. FLUID MOTION IN COCHLEAR MODELS. J.Tonndorf.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 558-68 (May, 1957).

Békésy-type, transparent models of the cochlea were used. Suspensions of aluminium dust in glycerin—water solutions provided frequency responses sufficiently high so as to improve the display of Békésy's "eddies" and to allow demonstration of particle motion within the "perilymphatic" fluid. The membrane displacement was found to vary with frequency, whereas the revolving velocity of the d.c. eddy currents varied with the square of frequency. The "bed" of each eddy was narrowest along the membrane and much wider elsewhere, as evidenced by a reciprocal variation in speed. A.C. particle motion (in response to pure-tone signals) was longitudinal proximal to and trochoidal (elliptical) alongside the membrane. In general, the elliptical orbits flattened out with distance from the membrane or from the eddy's mainstream upon which particle motion was superimposed. Along the membrane, the trochoidal pattern conformed to the changes of the travelling wave, while in the rebound portion of the eddy it became almost longitudinal. No a.c. particle motion was seen to occur beyond the eddy. A phase lag of a.c. particle motion, totalling 360°, accumulated gradually throughout the eddy so that particles in the inbound and rebound portions of the eddy were in phase opposition to each other. Orbits of a.c. particle motion resulting from stimulation by complex tones were observed also and analysed as Lissajou figures. A given relation between the partials of complex orbits remained unchanged throughout the eddy, although their relative magnitude did alter. In the case of beats, two separate patterns were observed in response to the beat frequency and to the intermediate frequency. This indicated that the model reacted nonlinearly to such stimulation. A.

612.858

8959. RESPONSE OF AN ELECTRICAL MODEL OF THE COCHLEAR PARTITION WITH DIFFERENT POSITIONS OF EXCITATION. B.P.Bogert.
J. Acoust. Soc. Amer., Vol. 29, No. 7, 789-92 (July, 1957).

Describes some measurements on the network representing the basilar membrane, which were made to determine the effect of the position of excitation on the response of the cochlear partition. It was found that the response of the electrical model is insensitive to the position of excitation if the excitation is applied on the stapes side of the point of maximum response. If the excitation is applied on the helicotrema side, the response is highly localized around the point of excitation and has an over-damped character. A.

612.858.71

8960. UNDERWATER HEARING THRESHOLDS. P.M.Hamilton.
J. Acoust. Soc. Amer., Vol. 29, No. 7, 792-4 (July, 1957).

Underwater hearing thresholds were measured at frequencies of 250, 500, 1000, 2000, and 4000 c/s on four Aqualung equipped divers with normal hearing in air. In the frequency range investigated, the minimum audible fields underwater are from 44 to 60 dB greater than the minimum audible fields in air, and the shape of the threshold v. frequency curve is different. A.

612.858.71

8961. IN SEARCH OF THE BONE-CONDUCTION THRESHOLD IN A FREE SOUND FIELD. J.Zwislocki.
J. Acoust. Soc. Amer., Vol. 29, No. 7, 795-804 (July, 1957).

Several investigators have attempted indirect determination of the bone-conduction threshold in a free sound field. It has recently become possible to attenuate sound transmitted through the auditory meatus to a level below that of a sound reaching the ear through other pathways. By varying the properties of sound-attenuating devices, and with the help of resonance phenomena, it could be shown that the remaining hearing was actually controlled by body conduction, if not more specifically by bone conduction. According to these measurements, the "minimum audible field" for body conduction (MAFB) exceeds 80 dB relative to 0.0002 dyne/cm² at low frequencies and decreases gradually to a minimum of about 45 to 50 dB between 1500 and 2000 c/s. For higher frequencies it increases somewhat again. The difference between body conduction and air conduction seems to be maximal in the vicinity of 500 c/s-approximately 65 dB. At frequencies around 100 c/s the difference is of the order of 50 dB. This difference holds also for the frequency range between 2000 and 6000 c/s. Between 1500 and 2000 c/s the difference is only about 45 dB. A.

612.858.74

8962. EFFECT OF TIME ON PITCH DISCRIMINATION THRESHOLDS UNDER SEVERAL PSYCHOPHYSICAL PROCEDURES; COMPARISON WITH INTENSITY DISCRIMINATION THRESHOLDS. E.König.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 606-12 (May, 1957).

Presents a study of the effect of the interstimulus interval on pitch discrimination in the cases of five different psychophysical procedures. These procedures were approximately analogous to those employed by Pollack for intensity discrimination. All the experiments described here for pitch discrimination were carried out at a constant sound level of about 40 dB above threshold, the mean reference frequency being 1000 c/s. The listeners examined were five young men with normal hearing acuity between the ages of 20 and 30. From the experimental data it appears that, irrespective of the method used, the mean over-all performance of the subjects in pitch discrimination deteriorates only slightly as the inter-stimulus interval increases from 1.25 to 5 sec. In order to stress the large discrepancies among the performance of the listeners, the data for each subject were reported with special care. The effect of stimulus duration on pitch discrimination is briefly discussed. A.

612.858.74

8963. AURAL HARMONICS ARE FICTITIOUS. M.F.Meyer.
J. Acoust. Soc. Amer., Vol. 29, No. 6, 749 (June, 1957).

The author criticizes the conclusions of Lawrence and Yantis (Abstr. 977/1957) that the beats between a test tone and a mistuned octave of the tone were due to aural harmonics. The author has shown that if tones of frequency 2n and (3n-d) are added, then the pitch 3n is heard beating at a rate 2d. 3n is not a harmonic of 2n, but a fifth in musical terminology. Will the believers in aural harmonics now also believe in "aural fifths"? The author urges those experimenters who use this "exploratory" method of Wegel and Lane to determine whether the beats are at a rate d, or 2d, and to study intervals other than the octave. "Aural harmonics" might have occurred if an overloaded telephone was used. D.J.Hall

612.858.74

8964. ON THE INADEQUACY OF THE METHOD OF BEATS AS A MEASURE OF AURAL HARMONICS. R.Chocholle and J.P.Legouix.
J. Acoust. Soc. Amer., Vol. 29, No. 6, 749-50 (June, 1957).

Figures given by Lawrence and Yantis (Abstr. 977/1957) show that the intensity level of the second aural harmonic, generated by distortion in the ear, could be of the same order as the level of the fundamental tone. These experiments by the method of beats are not in accordance with other facts: (1) Slightly different complex tones are easily discriminable; (2) The percentage distortion in the ear is probably low; (3) Measurements of cochlear microphonics on animals shows that aural harmonics only appear at high intensities. These and other considerations point to the inadequacy of the method, which does not take account of the possible interferences between the fundamental and auxiliary tones. D.J.Hall

612.858.74

8965. IN SUPPORT OF AN "INADEQUATE" METHOD FOR DETECTING "FICTITIOUS" AURAL HARMONICS.
M.Lawrence and P.A.Yantis.
J. Acoust. Soc. Amer., Vol. 29, No. 6, 750-1 (June, 1957).

See preceding two abstracts. Wegel and Lane's method has been occasionally criticized ever since it was first described. Meyer's objections seem to be: (1) The beats arise because of interaction on the basilar membrane according to Meyer's "hydraulic analysis" theory, rather than Helmholtz' transformation theory; (2) Beats at the rate of 2d c/s are heard, rather than d c/s, which would be predicted by the transformation theory. Chocholle and Legouix object because of the modulation of the fundamental by the exploring tone. Three experiments were designed to answer the above criticisms: (1) One can readily hear harmonics generated by the ear in response to a loud pure tone, and no exploring tone need be used. When an intense fundamental is fed to one ear, and an "exploratory mistuned octave" to the other, a binaural beat is produced which has a rate equal to the difference between the frequency of the exploring tone, and that of another tone which must be an aurally generated harmonic; (2) The beats heard between a tone of (2f + d) c/s, and a fundamental of f c/s is d, and not 2d c/s as stated by Meyer. The beats at 2d c/s are due to intermodulation distortion in the apparatus; (3) No appreciable modulation was observed on a wave analyser measuring the response of an animal's ear, but beating with the aural harmonic was marked. D.J.Hall

612.858.74

8966. ABOUT THE SENSATION OF BEATS BETWEEN TWO TONES WHOSE FREQUENCIES ARE NEARLY IN A SIMPLE RATIO.
R.Chocholle and J.P.Legouix.
J. Acoust. Soc. Amer., Vol. 29, No. 6, 750 (June, 1957).

Drawings, a cathode-ray oscillograph, and two loudspeakers mounted on the same panel, demonstrated that the addition of two sine waves whose frequencies were exactly in some simple ratio, produced slow but regular recurrences. When this occurred, the complex waveform appeared as a modulation of the lower frequency by the higher and the periodicity was equal to the lower frequency. When the frequencies differed by only a few c/s from a simple ratio, the gradual phase-shift increased and decreased the complex waveform peaks cyclically, at a periodicity which increased with the difference from a simple ratio, and which seemed to disappear when the difference was too great. When a listener heard sounds produced in these ways, he heard beats, particularly at low frequencies, but the origin of these beats is not interference between a tone and an aural harmonic of a lower tone. D.J.Hall

TECHNIQUE. MATERIALS 62/69

621.785 : 534.321.9

8967. EFFECTS OF ACOUSTICAL WAVES ON THE ANNEALING OF STEELS. H.V.Fairbanks and F.J.Dewez, Jr.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 588-92 (May, 1957).

The object of this investigation was to determine the effect of ultrasonic energy on 0.07 and 1.05% carbon steels during transformation from austenite to ferrite under controlled cooling. The ultrasonic energy was produced by means of a bowl-shaped crystal of barium titanate and was coupled to the steel samples through distilled water. Ultrasonic frequencies of 400 and 1000 kc/s were used. It was found that the ultrasonic treated samples of 0.07% carbon hypo-eutectoid steel had finer grain size, and greater hardness than the reference samples which had undergone the same heat-treating cycle but with no ultrasonic treatment. When either the intensity or the frequency of the ultrasonic energy was increased, the grain size was further decreased. For the 1.05% carbon hyper-eutectoid, it was found that the lamellar layers of ferrite and iron carbide making up the pearlite crystals were definitely thicker in the ultrasonic treated samples than in the untreated ones. Hardness tests made on the pearlite crystals substantiated the above results. A.

669 : 548.53

8968. THE ROLE OF EVAPORATION IN ZONE REFINING INDIUM ANTIMONIDE. K.F.Hulme and J.B.Mullin.
J. Electronics and Control, Vol. 3, No. 2, 160-70 (Aug., 1957).

Experiments on the refining of InSb are described; they include work with material heavily with zinc, cadmium, tellurium, and arsenic. Several lines of evidence show that the important acceptor impurities zinc and cadmium are volatile from molten indium antimonide. The removal of acceptors by volatilization under appropriate experimental conditions, followed by zone refining, can yield material with less than 10^{14} excess donors per cm^3. A.

PHOTOGRAPHY 77

771.535.01

8969. THE NATURE AND FORMATION OF THE PHOTOGRAPHIC LATENT IMAGE. J.W.Mitchell and N.F.Mott.
Phil. Mag. (Eighth Ser.), Vol. 2, 1149-70 (Sept., 1957).

A review is given of a theory of the nature and mode of formation of the photographic latent image and of the experimental evidence on which the theory is based. Earlier hypotheses due to Eggert and to Gurney and Mott are used, according to which the primary action of the light is to free photoelectrons and positive holes and the formation of silver specks involves the movement of silver ions. The stable latent image is seen as a positively charged silver speck on the surface of a halide grain, or in the case of internal image at a dislocation. The minimum stable image is a positively charged group of four silver atoms (Ag_4^+), the formation of which requires three electrons. The sub-image is a neutral pair of silver atoms and requires two electrons for its formation. A main role of silver sulphide is to provide traps for positive holes; after doing so the sulphide molecule dissociates into AgS and an interstitial cation. In terms of this model a discussion is given of reciprocity failure, development, the role of iodide and of other phenomena. A.

778.34

8970. SPURIOUS SCATTERING IN NUCLEAR EMULSIONS.
A.J.Apostolakis, J.O.Clarke and J.V.Major.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 337-46 (Feb., 1957).

Spurious scattering has been determined in two emulsion stacks, one exposed to 4.2 GeV π^--mesons from the Berkeley Bevatron and the other to cosmic rays at sea-level. In both stacks the mean modulus of the second differences of spurious scattering ($\bar{d}$) varies with cell-length (t) as $\bar{d} = at^b$ where b is approximately equal to unity and the constant a is different in the two stacks. In the first stack the spurious scattering is relatively small, and reliable measurements of $p\beta$ have been made at 4.3 GeV/c. In the second stack, spurious scattering is larger than in the π-meson stack and uncorrected measurements of $p\beta$ are reliable only up to about 2.5 GeV/c. The apparent value of $p\beta$ corresponding to the spurious scattering in this stack is about 5 GeV/c. The error on the value of $p\beta$ determined in the presence of spurious scattering is given. A.

778.34

8971. DETERMINATION OF DISTORTION VECTORS IN NUCLEAR EMULSIONS. Tsai-Chü.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1128-35 (May, 1957).

An attempt is made to determine distortion vectors by multiple scattering measurements made on inclined tracks both in projection and in depth. Distortion vectors of different orders can be deduced from formulae expressed in terms of ordinate differences of multiple scattering. The magnitudes of distortion vectors determined are in good agreement with those obtained by other methods. A.

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